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THESIS

PERFORMANCE ENHANCEMENTS TO JOINT ARMY/NAVY ROTORCRAFT ANALYSIS AND DESIGN (JANRAD) SOFTWARE AND GRAPHICAL USER INTERFACE (GUI)

by

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June 1998

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The Joint Army/Navy Rotorcraft Analysis and Design (JANRAD) computer program was developed at the Naval Postgraduate School to perform performance, stability and control, and rotor dynamics analysis during preliminary helicopter design efforts. This thesis is the continuation of a previous work in which a Graphical User Interface (GUI) was developed and implemented as the front end of the NPS program. Due to the complexity of the GUI design, only the Performance module of JANRAD was completed by the prior student. This thesis expands the capabilities of the Performance module, and the JANRAD code, by adding graphical output of performance results, improved rotor sizing capabilities, resources for user defined blade elements and non-linear blade twist, airfoil meshing capabilities, and additional reference airfoil data corrected for compressibility effects. It contains the basic architecture for the Stability and Control module GUI. Additionally, utilizing actual UH-60A Black Hawk airfoil and test flight data as inputs, JANRAD version 5.0 was run to validate its output with the test flight results, and those produced in a prior thesis by JANRAD version 3.1 (1995). Excellent agreement was demonstrated in all flight regimes. Utilizing airfoil data corrected for compressibility effects, high altitude runs resulted in much better correlation with test flight results than those experienced in 1995 using uncorrected airfoil data. A JANRAD Users Guide was updated and is included in Appendix A.

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PERFORMANCE ENHANCEMENTS TO JOINT ARMY/NAVY ROTORCRAFT ANALYSIS AND DESIGN (JANRAD) SOFTWARE AND GRAPHICAL USER INTERFACE (GUI)

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ABSTRACT

The Joint Army/Navy Rotorcraft Analysis and Design (JANRAD) computer program was developed at the Naval Postgraduate School to perform performance, stability and control, and rotor dynamics analysis during preliminary helicopter design efforts. This thesis is the continuation of a previous work in which a Graphical User Interface (GUI) was developed and implemented as the front end to the JANRAD program. Due to the complexity of the GUI design, only the Performance module of JANRAD was completed by the prior student. This thesis expands the capabilities of the Performance module, and the JANRAD code, by adding graphical output of performance results, improved rotor sizing capabilities, resources for user defined blade elements and non-linear blade twist, airfoil meshing capabilities, and additional reference airfoil data corrected for compressibility effects. It also contains the basic architecture for the Stability and Control module GUI. Additionally, utilizing actual UH-60A Black Hawk airfoil and test flight data as inputs, JANRAD 98 version 5.0 was run to validate its output with the test flight results, and those produced in a prior thesis by JANRAD version 3.1 (1995). Excellent agreement was demonstrated in all flight regimes. Utilizing airfoil data corrected for compressibility effects, high altitude runs resulted in much better correlation with test flight results than those experienced in 1995 using uncorrected airfoil data. A JANRAD Users Guide was updated and is included as Appendix A.

DISCLAIMER

Readers are also cautioned that the computer code in this thesis may not have been exercised for all cases of interest. While effort has been made, within the time available, to ensure that the program is free of computational and logical errors, additional verification should be applied. The use of this application is at the risk of the user.

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If you are reading this, it is finished!

I. INTRODUCTION

A. BACKGROUND

The Joint Army/Navy Rotorcraft Analysis and Design (JANRAD) computer code was originally developed by students at the Naval Post Graduate School (NPS) in response to the 1993 American Helicopter Society (AHS) Design Competition. The desire to develop an easy to use, accurate design tool was the motivation for a thesis completed by Nicholson (1993). This code has assisted the last 5 NPS Helo Design Teams garner 1st or 2nd place finishes in the AHS competitions, and the new version of JANRAD 98 proved its usefulness to this year's design team. The results from this competition will not be known until sometime in the fall.

JANRAD consists of three separate modules, each developed by different students. Design of the performance module and stability and control module are based on classical blade element theory. More detail on the design of these modules is given in Wirth (1993), Nicholson (1993), and Eccles (1995). Although separate, the stability and control module does require that the performance module be run first as it uses the resulting rotor trim conditions to calculate stability derivatives. The blade dynamics portion of JANRAD will not be discussed in this thesis.

The main performance function calculated 25 different helicopter performance parameters given 35 input parameters. The program was written in MATLAB® PC version 3.5 using a combination of script and function M-files. Inputs were made at the command line or loaded as a *filename*.mat file from the current working directory. The output was displayed in the main workspace and an option to save the output was also built into the program.

The stability and control module calculates a complete set of linearized stability derivatives for the helicopter by perturbing it from its "equilibrium" or "trim" condition which is calculated in the performance module.

Since JANRAD version 1.0 was initially developed, many features have been added. A section for Rotor Dynamics, was developed by Hiatt (1995). Minor updates have included time varying tip loss analysis, the ability to calculate performance characteristics over a range of selected input parameters and the addition of airfoil choices. Eccles (1995) validated the code by conducting a detailed comparison between JANRAD version 3.1 and Sikorsky UH-60A and H-34 measured flight test data. JANRAD results predicted power required within 2% for altitudes below 6000 feet MSL.

The motivation for this thesis is the prior work done by Lapacik (1998) on the development of JANRAD version 4.0. Better known as JANRAD 98, the thrust of version 4.0 was development of a Graphical User Interface (GUI) to simplify operation of the JANRAD code. A major complaint by past users was the excessive amount of time it took to work within the command window of MATLAB®, and the lack of reliability or robustness of the program. Through development of a "Windows® " type interface tied to the existing code, users can now quickly make multiple runs varying input parameters to accomplish preliminary design efforts including; sizing of engines and transmissions, rotor blade design, tail rotor design, and calculating performance characteristics of chosen designs.

B. JANRAD 98 VERSION 4.0

The development of JANRAD 98 version 4.0 was accomplished utilizing tools only recently available with the release of MATLAB® version 5.0. The most important of these, a function called GUIDE® (Graphical User Interface Design Environment) allows the developer to create interactive screens which resemble those of Windows®, using "drag and drop" controls or objects obtained from a master pallet. Transparent to the

GUI developer, MATLAB® 5 automatically writes the code required to create the screens. These screen displays significantly improve the look, speed, and ease of use of the program. Figure 1 depicts the GUIDE® Control Panel. Other important features of MATLAB® 5 are the use of variable "structures", and the Editor/Debugger. Structures can be built to contain multiple variables, requiring the programmer to pass only one variable name to the different m-files and functions. This is invaluable when dealing with the large numbers of files associated with JANRAD 98. The Editor/Debugger automatically indents and highlights specific MATLAB commands making it easier for the programmer to find and correct errors, and making the code much easier to read.

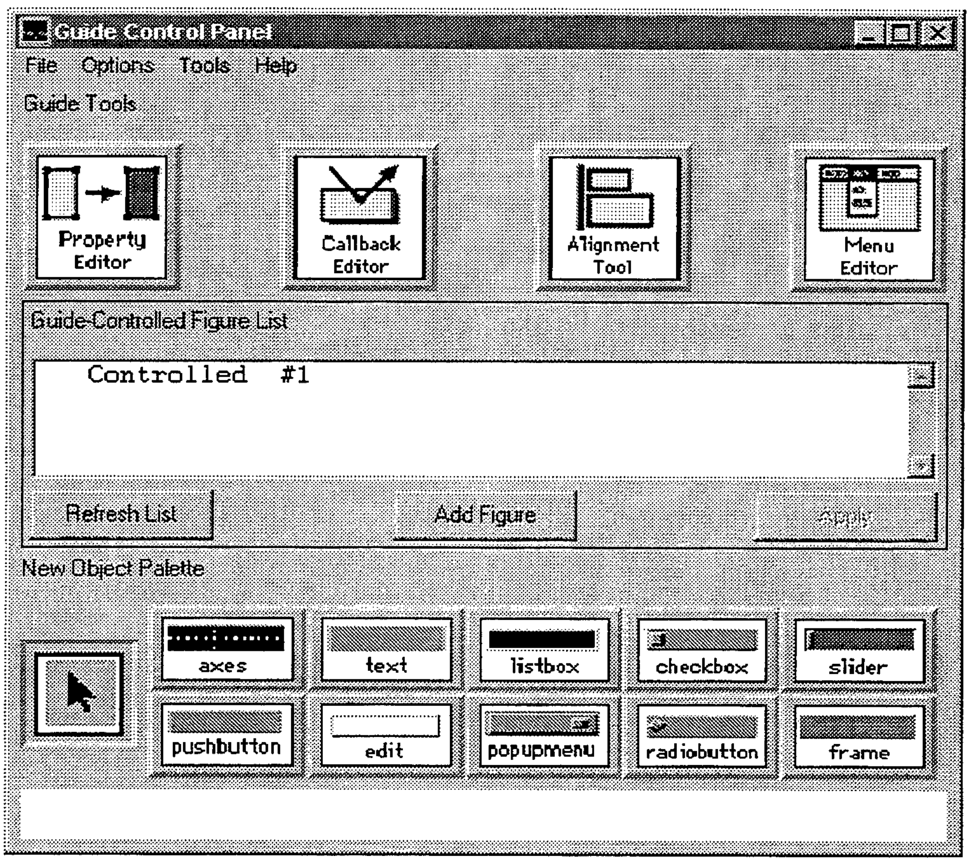


Figure 1. The GUIDE® Control Panel from MATLAB® 5.

Specific details on the development of the GUIs are outlined in Dean (1997), and Lapacik (1998). This "front end" design makes utilizing the code, or back end, essentially transparent to the user. Where once the user was prompted to provide or ask for 35 input parameters, he now only must select a pre-compiled data file which contains these parameters. Figure 2 is a sample of the command line of the old JANRAD version 3.1. Imagine having to go through and select any number of the 35 such input lines, one at a time. In contrast, Figure 3 displays the input parameters screen of JANRAD 98. The values from the selected data file are displayed automatically. Modification of any of the inputs is easily accomplished by simply overwriting the displayed values.

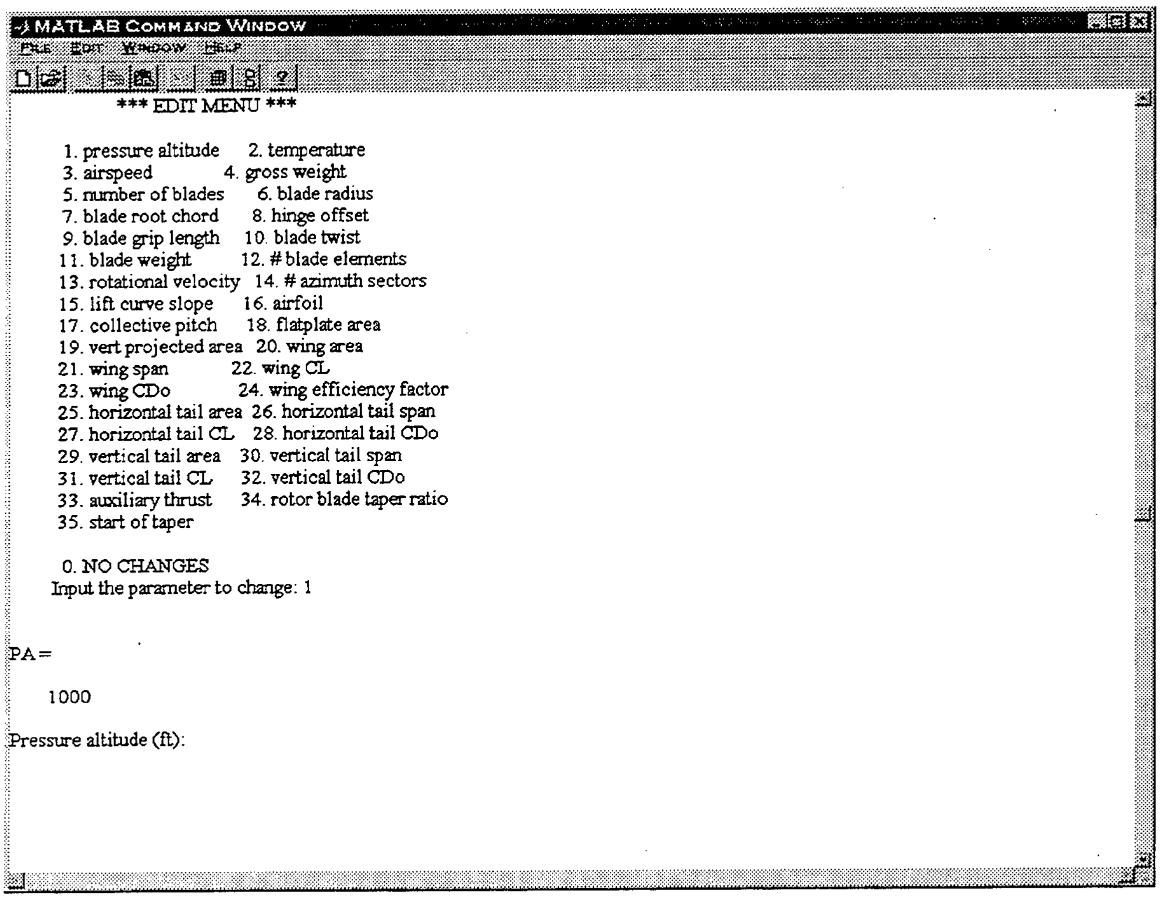


Figure 2. Sample Input Command Window of JANRAD version 3.1

The interfaces for several of the performance module improvements are contained on this screen. Each of them will be discussed in detail in section II. With the GUI implementation, JANRAD was transitioned from a slow, command line program, reminiscent of MS DOS, to a much more efficient, better looking program more in line with some of the latest professional engineering software packages. Due to time constraints on the previous author, however, several design functions of the Performance module were not completed.

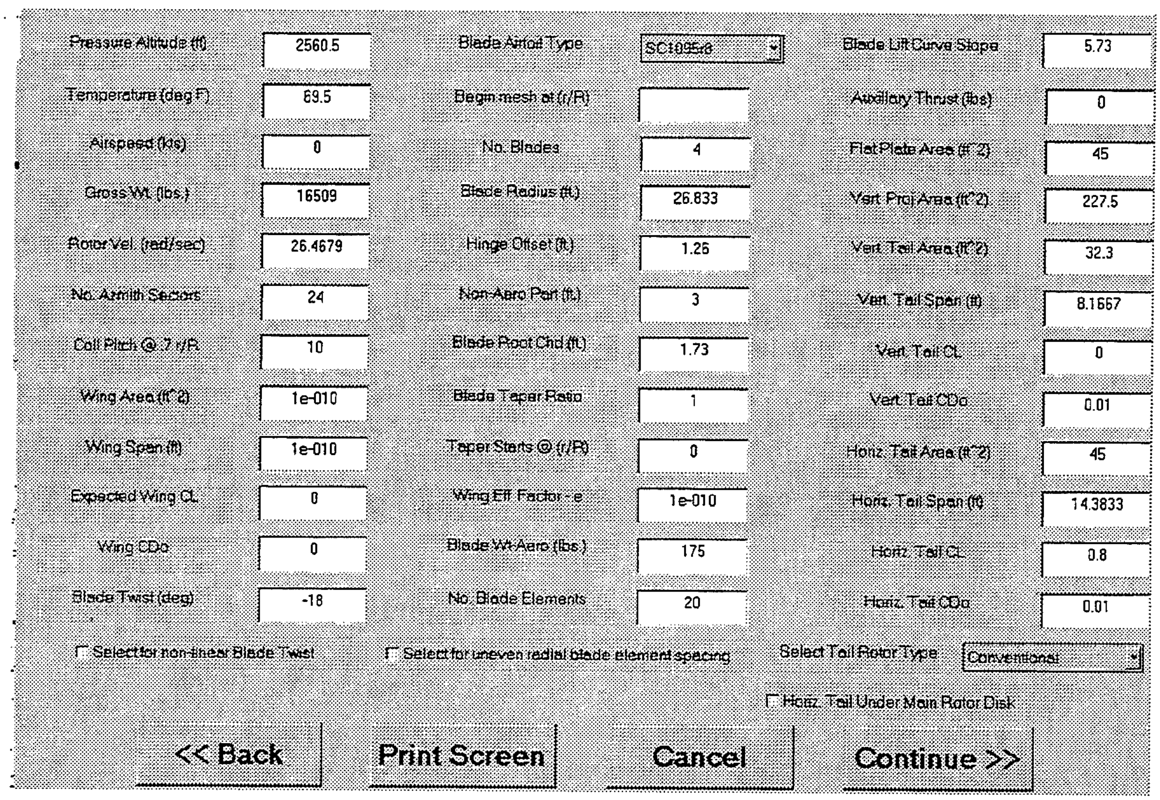


Figure 3. JANRAD 98 Performance Input Parameters Screen

C. JANRAD 98 VERSION 5.0 PERFORMANCE MODULE

JANRAD 98 version 5.0 is primarily a continuation of Lapacik's (1998) work by this writer. This author spent approximately six weeks working with Lapacik to develop the requisite GUI and Performance module knowledge necessary to take over the work where he left off. Accomplishments during that period included:

- Code required to display directory and files available to the user.
- Code required to display values in Performance Input screen.
- Design of callbacks allowing user to change the values of variables.
- Code required for MATLAB® to save and print input, output, and matrix files.
- Actual tying together of the GUI with the existing JANRAD code.
- Creation of basic status display showing user the progress of Performance run.
- Modification of JANRAD version 3.1 code and variables to correspond with JANRAD 98 use of structures and graphics handles.
- Addition of Sikorsky airfoil CL and CD data, and construction of code allowing its use.
- Integration of different GUI screens ensuring smooth and proper transfer between them with proper variable values being passed.

All of these accomplishments are included in JANRAD 98 version 4.0 but play a large role in the accomplishment of version 5.0 improvements to the Performance module. The major areas of emphasis in this thesis for the completion of the module were as follows:

- Tie in existing JANRAD 3.1 graphical output capabilities and develop additional capabilities.
- Improve the visual status display to keep user better informed of program progress during runs.

- Improve existing airfoil data by obtaining manufacturer's data corrected for compressibility effects (Mach number dependent), and implementing this data into JANRAD 98 version 5.0.
- Develop a method to allow the user to input a vector of desired blade element dimensions vice a computer generated element vector.
- Develop a method to allow user to add an additional airfoil at any desired blade station as is done in many advanced airfoil designs.
- Develop a method to allow the user to specify the blade twist at any blade station rather than assume a linear blade twist.
- Add GUI screen to allow user to select type of tailrotor and input tail rotor parameters.
- Adjust program to allow for performance calculations on compound helicopters and compounds with auxiliary thrust.
- Add main rotor radius and main rotor speed iteration methods to improve rotor sizing capabilities of the program.
- Re-run several test flight scenarios from Eccles (1996) utilizing correct Sikorsky airfoil data and compare results to those of actual UH-60 test flight data.

Each of the above improvements are discussed in detail in section II.

D. JANRAD 98 VERSION 5.0 STABILITY AND CONTROL MODULE

An initial goal of this thesis was to complete as much of the Stability and Control module GUI implementation as time would allow. Interest by another student in continuing the thesis work allowed for a pass down period on GUI design and MATLAB® code integration. Using the Stability and Control code written by Wirth (1993) and the GUI design methods of Lapacik (1998) and Dean (1997), the intial input screens for the module were created. These GUI screens are included as Figures 12 and 13.

E. USER's GUIDE

A User's Guide is attached as Appendix A and gives an overview of the major features and procedures for using JANRAD version 5.0. Originally developed by Lapacik (1998) for version 4.0, this guide has been updated to include the improvements of version 5.0. Additionally, the guide will give an introduction to the Stability and control module usage procedures.

F. JANRAD 98 VERSION 5.0 FILE STRUCTURE FLOW CHART

An updated flow chart which tracks the files and Callback operations of JANRAD 98 version 5.0 is included as Figure 4. The files referenced in the flow chart are included as Appendices.

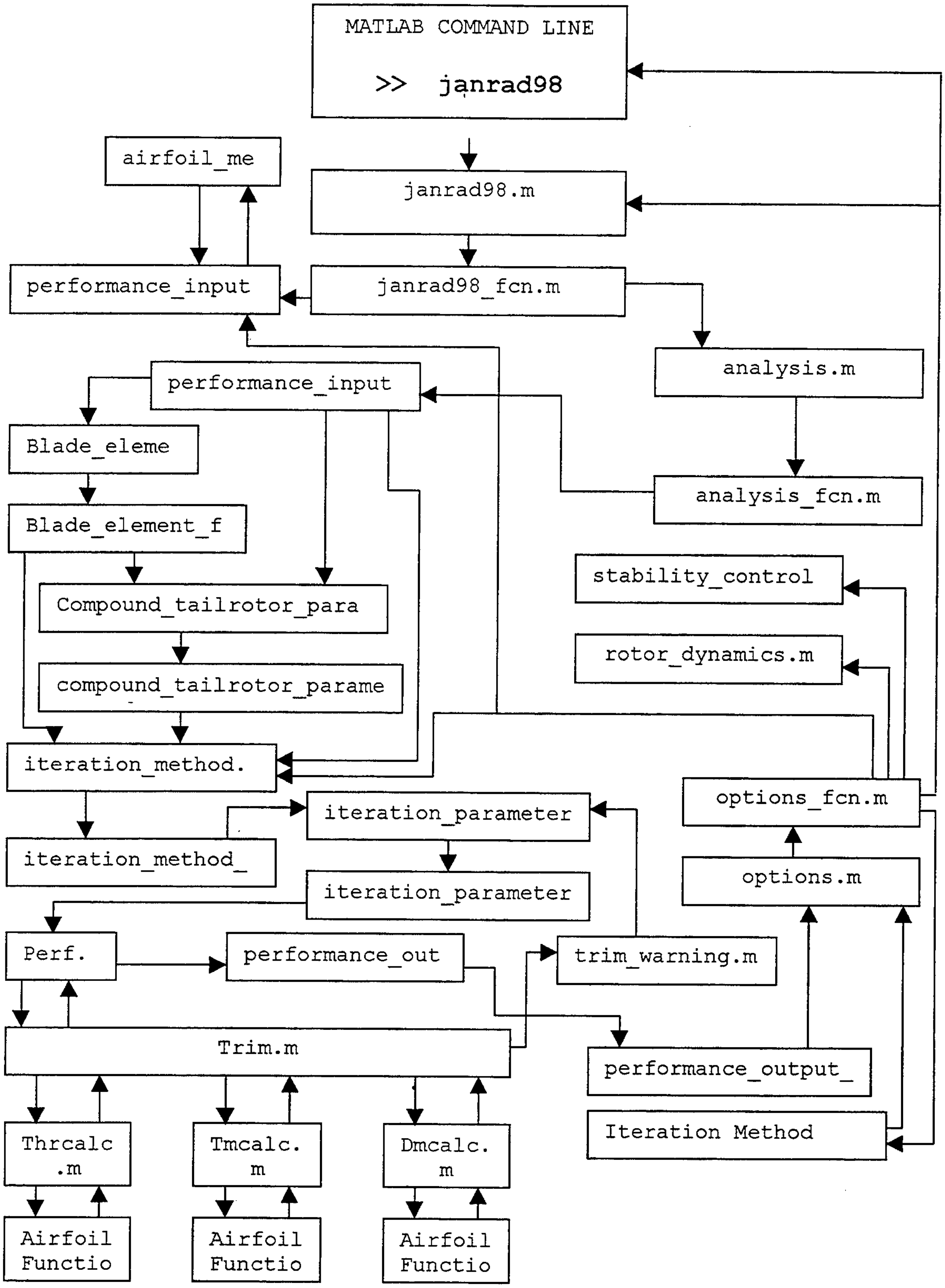


Figure 4. JANRAD 98 version 5.0 File Structure Flow Chart

II. JANRAD VERSION 5.0 IMPROVEMENTS

A. TIED IN EXISTING JANRAD 3.1 GRAPHICAL OUTPUT CAPABILITIES AND DEVELOP ADDITIONAL CAPABILITIES

The earlier versions of JANRAD, including JANRAD version 3.1, contained limited graphical output capabilities. Those plot routines present in version 3.1 were customized by previous users to fit their output needs. To provide the flexibility necessary for users to extract desired information from the performance results, a number of available plots were designed for each of the different iteration methods. The Airspeed Iteration plot screen is displayed as Figure 5. Any or all of the available plots may be selected by the user.

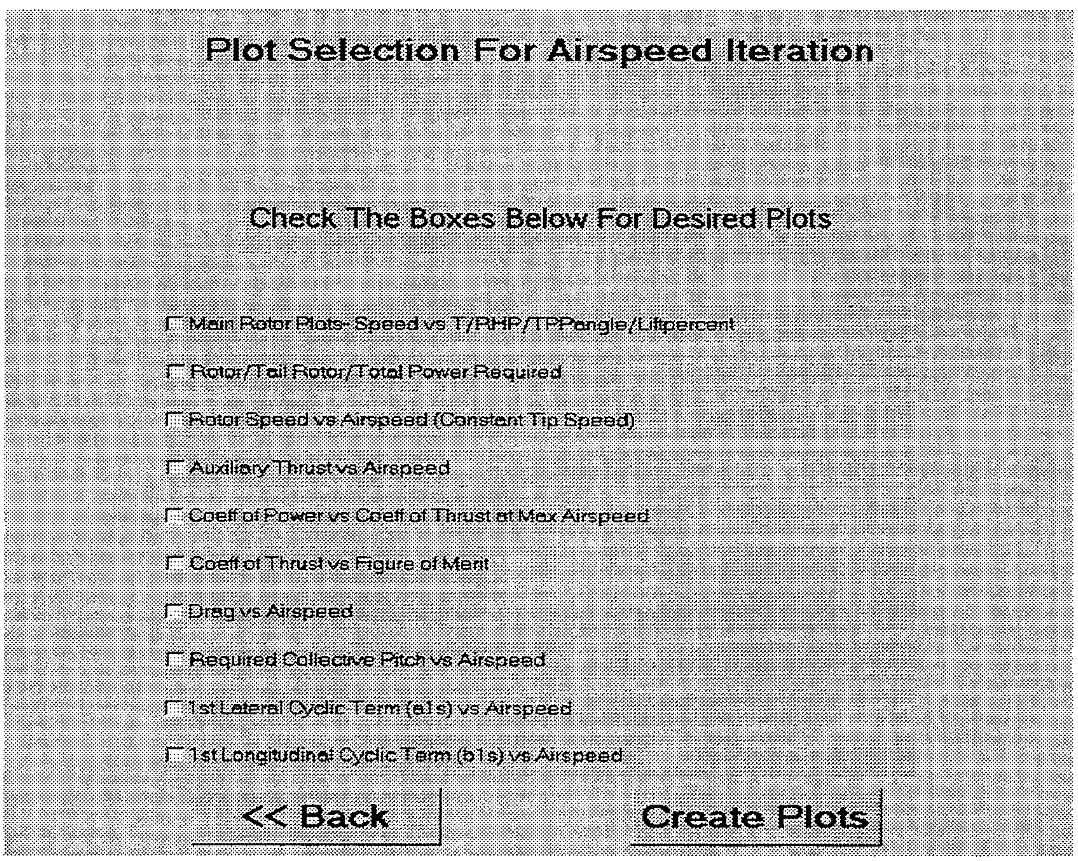


Figure 5. Airspeed Iteration Plot Screen

Figure 6 shows the Power Required plot for an airspeed iteration from 50-120 knots. Separate GUI screens were developed for each of the iteration methods. When the user selects the available "PLOT" option, the pertinent screen appears allowing them to select the desired plots. Upon selecting the "Create Plots" button, a MATLAB® file, known as an m-file, creates the plots. Most of the plots are created utilizing calculated performance outputs, however, some prompt the user for additional parameter inputs.

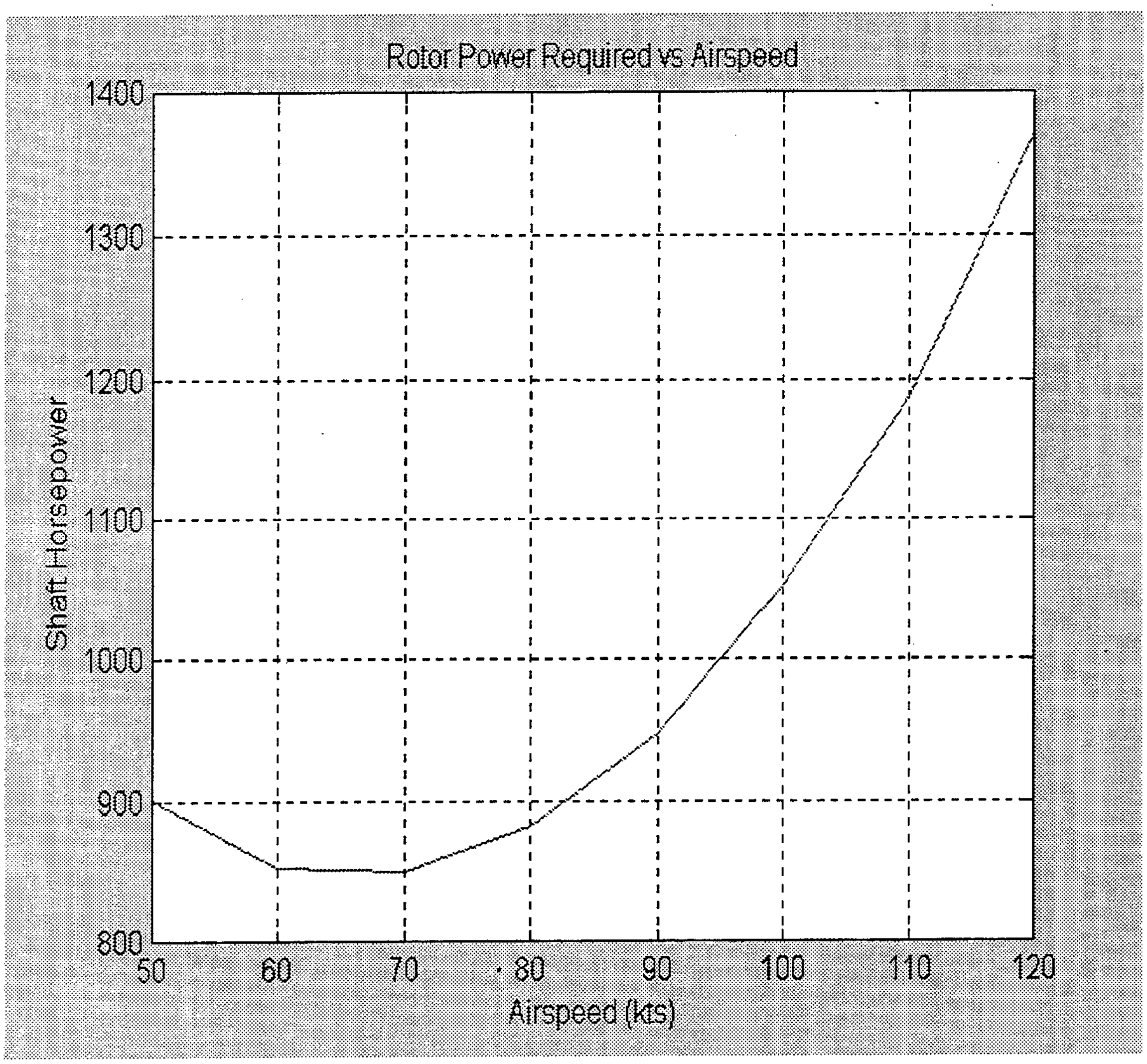


Figure 6. Rotor Power Required vs. Airspeed Plot

B. IMPROVED THE VISUAL STATUS DISPLAY TO KEEP USER BETTER INFORMED OF PROGRAM PROGRESS DURING RUNS

The early versions of JANRAD, (i.e. version 3.1) contained a series of status lines which displayed on the MATLAB® command window to keep the user advised of the status of the run. One problem with the use of the GUI is that the code runs in the background and therefore is mostly transparent to the user. Due to the extended run times involved with some scenarios, it was desired to develop a means of keeping the user informed of the status of the run. Figure 7 is a representative status during a JANRAD 98 version 5.0 run. The right half of the screen shows the four status boxes created to inform the user which part of the trim sequence is being completed, the elapsed time of the run, the iteration number of the trim sequence which is being completed, and the value of the iteration method variable.

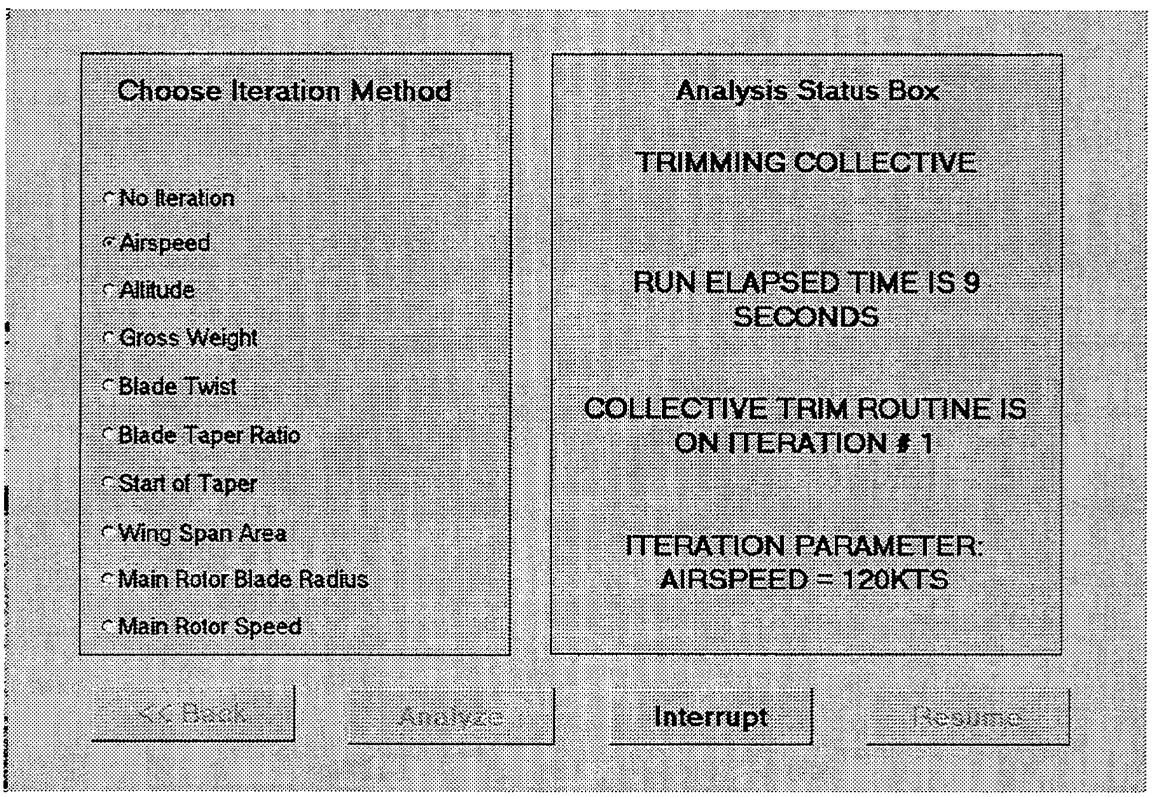


Figure 7. Analysis Status Box

C. IMPROVED EXISTING AIRFOIL DATA BY OBTAINING MANUFACTURER'S DATA CORRECTED FOR COMPRESSIBILITY EFFECTS (MACH NUMBER DEPENDENT), AND IMPLEMENTING THIS DATA INTO JANRAD 98 VERSION 5.0

One of the major recommendations of Eccles (1995) was to attempt to obtain airfoil data corrected for mach number and kinematic viscosity so that the program would be more reliable at altitudes above approximately 8-10,000 feet. He was able to add NACA 0012 data which was mach number dependent, but both the VR12 and HH02 airfoils provided single CL and CD curves. This author was able to obtain new data from both Sikorsky and Boeing which provide CL and CD curves for mach numbers from 0.0 up to 1.0. Since pressure altitude is an input parameter for the performance routine and mach number varies with altitude, the discrepancies at high altitudes shown by Eccles (1995), should be reduced or eliminated. As will be shown later in the validation section of this thesis, the results obtained using mach number dependent airfoil data agree much closer with UH-60 flight test data than that produced by Eccles with the single curve VR12 data. The addition of the Sikorsky data brought the airfoil database in JANRAD 98 version 5.0 up to 6 airfoils. They are the HH02, VR12, VR15, NACA-0012, Sc1094R8, and the Sc1095R8. For this data, we have compressibility corrected data in the cases of the VR series airfoils (Boeing), the SC series airfoils (Sikorsky), and the NACA-0012 airfoil (UTRC). Additionally, the interpolation capabilities of MATLAB® were utilized requiring only tabulated data and not the curve fitted polynomials utilized by Nicholson and Eccles. This results in more accurate CL and CD values being utilized in the trim routine. Appendix B contains summary CL and CD plots for the VR12, VR15, Sc1094R8 and Sc1095R8 airfoils to allow a user to match requirements of any particular design.

D. DEVELOPED A METHOD TO ALLOW THE USER TO INPUT A VECTOR OF DESIRED BLADE ELEMENT DIMENSIONS VICE COMPUTER GENERATED ELEMENT VECTOR

The JANRAD code creates a vector of blade element location dimensions based on main rotor radius and the number of blade elements input by the user. For some applications it may be desired to replace this "evenly spaced" vector to allow the user a better picture of what is happening at a specific blade station. This capability would allow the user to increase or decrease the spacing of the blade elements at will. Used in conjunction with user defined blade twist, the user can specify the blade dimension and corresponding blade twist. By choosing to enter unevenly spaced blade elements on the input parameters screen, the user is presented by a screen (Figure 8), on which the blade element dimensions may be entered.

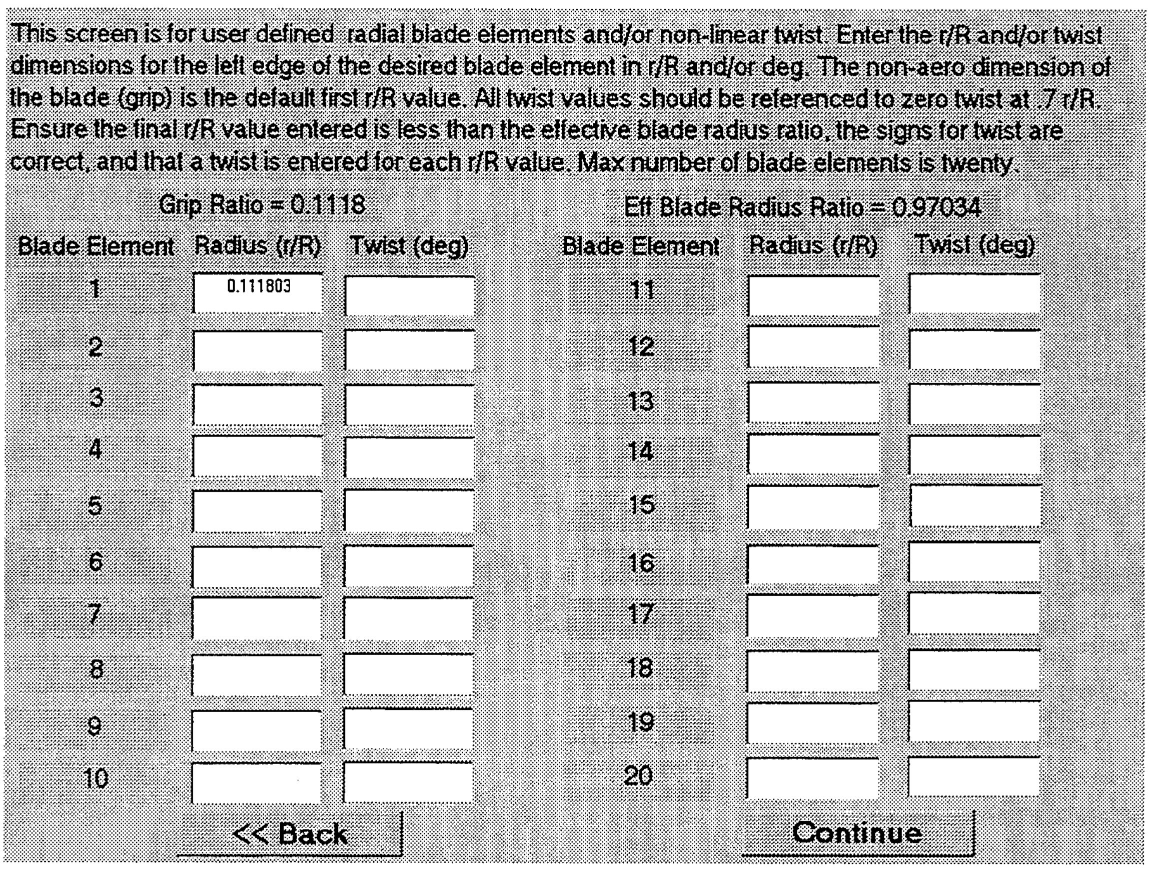


Figure 8. User Defined Blade Element and Blade Twist Screen

The non-aerodynamic dimension of the blade, or "Grip Ratio" (an input parameter accounting for the blade root end), is automatically entered as the default first blade element location. Additionally, the "Effective Blade Radius Ratio" (provides for tip loss), is calculated and displayed. This is the same screen on which nonlinear blade twist entries may be made. Nonlinear blade twist will be discussed in a following section.

After blade element location dimensions are entered, JANRAD 98 version 5.0 calculates the element spacing and adjusts the dimensions to the center of each element. Built in error detection gives the user an error message if a dimension greater than the effective blade radius is entered. Once constructed, this vector of blade elements is utilized for performance calculations by JANRAD 98 version 5.0. At this point in the program, no blade element is created out past the effective blade radius. Later an adjustment is made so that profile drag forces on the tip of the blade are accounted for, but lift forces are zeroed out.

E. DEVELOPED A METHOD TO ALLOW USER TO ADD AN ADDITIONAL AIRFOIL AT ANY DESIRED BLADE STATION

Many advanced rotor blades are made up of more than one airfoil section. This "meshing" of airfoils provides for better airfoil performance due to the use of varied airfoil thickness and shapes. It is primarily utilized out near the rotor tip. In order to more accurately model rotor performance, it was desired that JANRAD 98 version 5.0 have this capability. Added as an option on the performance input screen, the user can choose to perform an airfoil mesh and specify at what r/R value it should occur. Upon entering this value a screen appears which allows selection of the two airfoil types. In all performance calculations the CL and CD curves for the appropriate airfoils are utilized. Although it is conceivable that some blades may utilize more than two airfoil types, JANRAD 98 version 5.0 allows the use of only two airfoils. Figure 9 shows the airfoil mesh screen. If the user allows the program to generate a vector of blade elements and then selects a mesh point which does not align with a blade element, a logic statement

calculates the closest existing blade station to that selected by the user for the mesh. Therefore, there may be a small discrepancy in where the mesh takes place with that selected. This should have a negligible effect on the output. If the user desires an exact mesh point then the uneven blade element feature should also be selected.

F. DEVELOPED A METHOD TO ALLOW THE USER TO SPECIFY THE BLADE TWIST AT ANY BLADE STATION RATHER THAN ASSUME A LINEAR BLADE TWIST

As was discussed in the blade element section, it is no longer common practice to have a linear twist over the length of the rotor blade. Previous versions of JANRAD were based on the assumption that twist was linear. To account for non-linear twist it was necessary to make changes to the way JANRAD 98 version 5.0 calculated the twist at each blade element. Utilizing the blade element/blade twist screen shown in Figure 8, it is now

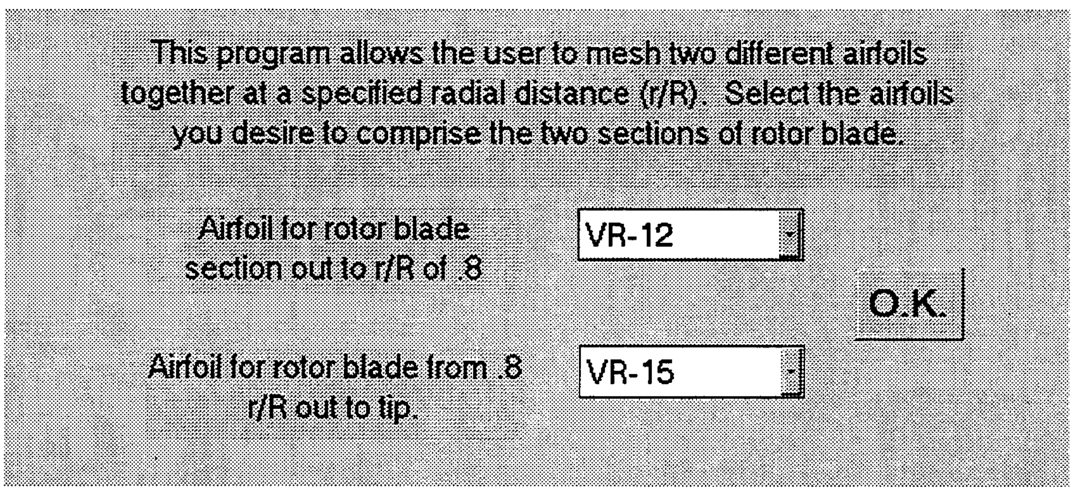


Figure 9. Airfoil Mesh Selection Screen

possible for the user to calculate the twist at any desired blade element dimension and input the value. Figure 10 illustrates the blade structural twist of the UH-60A rotor blade. Although mostly linear, the twist varies a great deal out near the tip resulting in a "fish hook." This drastic change in twist helps optimize aerodynamic characteristics out near

the tip. Similar to the blade element calculations, the blade twist at the left edge of a blade element is entered. The code is written to calculate the length of the blade elements, adjust the twist output to the middle of the element, and calculate the new twist value at this position. If the right edge of the last blade element does not happen to correspond to the effective blade radius, a value for the twist of that element will not exist. The code is written such that the slope of the twist vector from the previous blade element is utilized to calculate the twist for the last element. If this approximation is insufficient, as it would be for the UH-60 twist distribution, the user would have to vary his blade element spacing to decrease the spacing out near the tip to capture this twist variance.

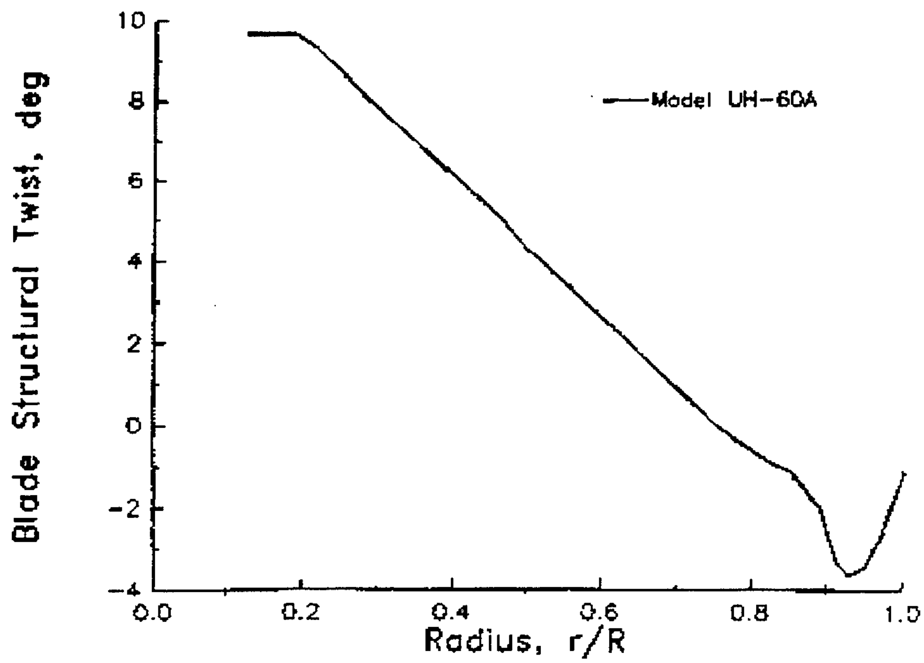


Figure 3. Blade structural twist.

Figure 10. UH-60A Blade Structural Twist

G. ADDED GUI SCREEN TO ALLOW USER TO SELECT TYPE OF TAIL ROTOR AND INPUT ROTOR PARAMETERS

A major problem noted by past users of JANRAD was that program changes were introduced each year by the student design teams utilizing it for the AHS Design competition. This was no more evident than in the code written to calculate tail rotor performance parameters. In reviewing the code during this thesis it was discovered that JANRAD was restricted to calculating the performance of a fan-in-tail type of tail rotor. Again, to increase the flexibility of JANRAD version 5.0, a selection was added to the performance input screen which allows the user to choose between a conventional tail rotor, fan-in-tail or notar. A screen was then added allowing the user to enter tail rotor dimensions and parameters. The performance of the tail rotor, based on the user inputs, is calculated and included in many of the graphical output plots. The tail rotor parameters input screen is included as Figure 11.

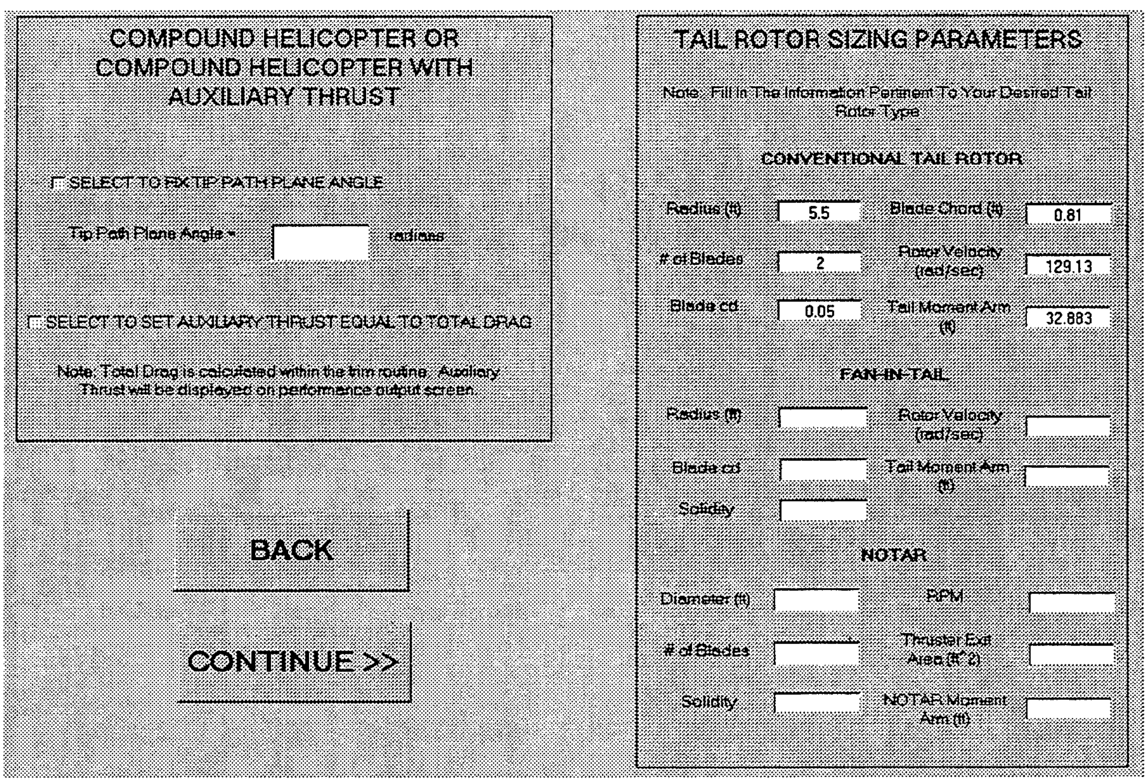


Figure 11. Compound Helicopter and Tail Rotor Input Parameters

Time constraints only allowed for the conventional tail rotor code to be fully implemented. Although the displays for the other types are included, The underlying JANRAD code has not been completed. For the conventional helicopter input, rotor speed multiplied by rotor radius is assumed to be equal for the main rotor and tail rotor. That is, tail rotor rpm is selected on the basis that main and tail rotors have the same tip speed. A default value for tail rotor speed based on this relationship is displayed on the tail rotor parameters input screen.

H. ADJUSTED PROGRAM TO ALLOW FOR PERFORMANCE CALCULATIONS ON COMPOUND HELICOPTERS AND COMPOUNDS WITH AUXILIARY THRUST

The 1998 AHS Student/Industry Design competition RFP calls for a rotorcraft designed to carry passengers in the Northeast corridor. To meet requirements, the design team selected a compound helicopter with auxiliary thrust capable of reaching speeds of 180-210 knots. During preliminary design work the need for additional capabilities from JANRAD 98 version 5.0 became evident. Early versions of JANRAD (i.e. version 3.1) had capabilities of providing auxiliary thrust and a wing, but did not allow for scheduled control of the the tip path plane angle of the main rotor, or varying the amount of thrust as a function of the drag of the aircraft. The left half of Figure 11 was designed to provide these input capabilities. User inputs lead to a variance from the original JANRAD code, setting the tip path plane to any desired angle and/or allowing an auxiliary thrust schedule. This can be manipulated to vary as airspeed, wing area or other parameters, and the resulting drag, change. This added feature allows the user to optimize a compound helicopter design by observing the effect of small changes made to the tip path angle or auxiliary thrust.

During the design team's work it was found that setting the tip path plane angle to zero in cruise flight while allowing the auxiliary propeller to provide the required horizontal thrust minimized rotor drag for a positive savings in total power required. Future improvements to this capability would be to automate the capability of setting an auxiliary thrust schedule for any desired airspeed range and/or varying the tip path plane angle with airspeed or flight regions (hover, climb, cruise, etc). Additionally, a method to set the desired percentage of lift that the wing should carry at any airspeed by varying collective would be beneficial.

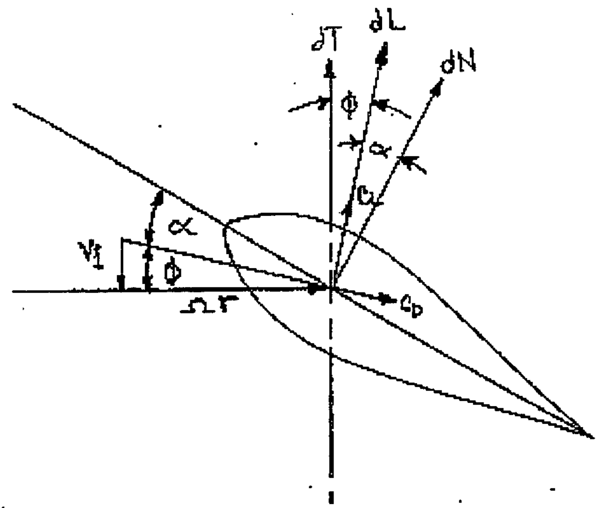
I. ADDED MAIN ROTOR RADIUS AND MAIN ROTOR SPEED ITERATION METHODS TO IMPROVE ROTOR SIZING CAPABILITIES OF THE PROGRAM

The primary purpose of the JANRAD Performance module is for sizing main and tail rotors, and engines during preliminary design of a helicopter. To properly do this one must be able to vary rotor radius and rotational speeds to find their optimum values. To better aid this goal, two additional iteration methods were added to the JANRAD iteration methods screen. These are Rotor Radius and Rotor Speed. As described in Lapacik (1998), these methods allow the user to specify minimum, maximum and interval values. The performance module is then run and generates vectors of output, which may be plotted to provide the user with desired performance data.

J. IMPLEMENTED LIFT DISTRIBUTION PLOTS TO BETTER MATCH FLIGHT TEST DATA

When aircraft such as the UH-60A are instrumented for flight tests, pressure transducers are used on the blades to measure the pressure differentials at specific radial locations. These pressure differences directly represent the incremental lift or normal force (dN) of the blade at that location. Traditionally, computer simulation models have output thrust distributions (dT) on rotor blades instead of lift distributions. The distinction is that the incremental thrust vectors are aligned parallel to each other and

parallel to the rotor axis of rotation. This discrepancy raises the question of whether there are significant differences between the two. Figure 12 shows a blade element with both thrust and lift vectors, and their components represented. The equations for calculating incremental thrust and lift are also shown.



$$dT = 0.5*\rho*cblade*dr*(Up\verb|^|2+Ut\verb|^|2)*(CL*\cos(\Phi)-CD*\sin(\Phi));$$

$$dN = 0.5*\rho*cblade*dr*(Up\verb|^|2+Ut.\verb|^|2)*(CL*\cos(\alpha)+CD*\sin(\alpha));$$

Figure 12. Lift and Thrust Vectors for Blade Element in Forward Flight

To examine this question the equations for lift were added into JANRAD 98 version 5.0, and plots identical to the thrust distribution plots were created. Sample thrust distribution and lift distribution plots for the UH-60A at 115 knots are contained in Appendix F. These show that there is minimal, if any, difference between the two plots. Therefore, thrust distribution plots, labeled as airload plots, will continue to be used throughout this thesis.

III. REPLICATION OF TEST FLIGHT SCENARIOS FROM ECCLES (1996)

A. BACKGROUND

In 1995, LT David Eccles completed a thesis which, in part, set out to validate the results of then JANRAD version 3.1 with Sikorsky UH-60A test flight data gathered from NASA's Ames Research Center. Given the ability to access NASA's Tilt Rotor Engineering Database System (TRENDS), he was able to download data gathered from extensive test flights of a fully instrumented UH-60A. Through data manipulation, described in detail in his thesis, he generated plots of airload distribution across the rotor disk, power required at various airspeeds ranging from hover to cruise, and thrust moment variations with azimuth. Although his results in most instances validated JANRAD's calculations by producing results matching very well those of NASA, the correct airfoil data of the UH-60A were not available to him at that time. In place of the UH-60A airfoil data, he used the Boeing VR-12 airfoil. This data had originally been provided NPS in 1993 for the full angle of attack range to 360 degrees. The data also included compressibility corrections at lower angles of attack in increments of Mach number from 0.0 to 1.0. Between 1993 and 1995 the compressibility corrections were removed from this data. LT Eccles was unaware of this, and as a result, did not have compressibility effects properly accounted for in his work to validate the UH-60A. As a result, there were major disparities between JANRAD's outputs and the UH-60A flight test data at altitudes above 8,000-10,000 feet as reported in Eccles (1995). At these altitudes there is significant variation in Mach number due to decreased density of the air.

B. ROLE OF JANRAD 98 VERSION 5.0 IMPROVEMENTS

The addition of the Sikorsky Sc1094R8 and Sc1095R8 airfoil data has provided what is hoped to be a solution to the high altitude output variations from the test flight data experienced by Eccles (1995). Mach number is calculated by JANRAD before accessing the CL and CD tables, and it will vary for a given airspeed as the pressure

altitude increases and the air density decreases. The Sikorsky data is tabulated according to angle of attack from –180 degrees to 180 degrees for the following Mach numbers; 0.0, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0.

The airfoil mesh capability of JANRAD version 5.0 will allow for the blade to be modeled closely approximating the actual UH-60A blade. The Sc1095R8 airfoil is utilized from the blade root out to approximately 0.8 r/R and than the Sc1094R8 is utilized from that point out to the tip. The mesh point and airfoils can be readily selected on the performance input screen.

The blade element and non-linear blade twist screen can be utilized to model the structural twist of the UH-60 rotor blade as is shown in Figure 10. Eccles (1995) utilized the equivalent linear twist of –18 degrees for his thesis.

Using the graphics capabilities added to JANRAD 98 version 5.0, the airload plots contained in Eccles' thesis can be easily created to verify data. For the purpose of the qualitative analysis of results, these plots will be modified to contain all three sets of data; Eccles, Test Flight results, and JANRAD version 5.0 results.

C. RESULTS

1. Inputs to JANRAD version 5.0

Inputs were initially held to those values used by Eccles except in the case of the Sikorsky airfoil data and blade twist distribution. The flight conditions for the different test flights were also utilized to more closely replicate results. After several attempts to replicate power required plots proved unsuccessful, these inputs were examined. It was discovered, after discussions with Sikorsky Aircraft, that the equivalent flat plate areas that had been used were too large. The basic flat plate area used in their performance models is 30 square feet and it is adjusted based on fuselage angle of attack and center of gravity location. It is also corrected for stabilator incidence. Therefore, a range of 26-40

feet was used with the demarcation ranges listed below in Table 1. These areas were added into the JANRAD 98 version 5.0 code. Additionally, Eccles (1995) had used a value of 0.7 for the horizontal tail coefficient of lift resulting in a lift value of nearly 3000 pounds at the horizontal tail at 160 knots. As the present JANRAD rotor trim code trims for the case where the aircraft center of gravity lies on a vertical line through the axis of rotation of the main rotor hub, it is believed that large offset force would have introduced errors into rotor trim results and ultimately, power required calculations. This was corrected by obtaining from Sikorsky their values for horizontal tail loading versus airspeed. At slow speeds, negligible horizontal tail loads exist. For a 16,450 pound gross weight helicopter, at 160 knots with a slightly forward center of gravity, their test data showed a download of 1460 pounds at the horizontal tail. A linear approximation of this download was placed into the JANRAD 98 version 5.0 code to help account for the power requirement which will be associated with it. Further discussions with Sikorsky centered around the non-linear twist of the UH-60A rotor blade. They approximate this in their analysis by using a linear equivalent twist of 14-16 degrees. A median value of 15 degrees was used for all JANRAD power required runs.

Airspeed	**0 to 50 Kts**	**50 to 90 Kts**	**90 to 140 Kts**	**140 to 160 Kts**
Flat Plate Area	**35 ft^2**	**32 ft^2**	**30 ft^2**	**28 ft^2**

Table 1. Equivalent Flat Plate Area Values for the UH-60A Model

2. Airloads

Preliminary JANRAD runs in which the actual twist of the UH-60A rotor blade was approximated showed a spike in the radial distribution of lift along the blade. This occurred at a point along the blade that corresponded to the location of the start of the

"fish hook" twist distribution. Three possible explanations for this phenomena were postulated ; (1) the tapering or camber of the meshed section of Sc1094R8 airfoil used at the tip of the actual UH-60 blade is not modeled correctly in JANRAD 98 version 5.0; (2) there are significant 3-D tip vortex effects present on the UH-60A blade normally compensated for by the "fish hook" which were not accounted for in the JANRAD 98 version 5.0 model; and (3) the UH-60A swept blade tip is not modeled in JANRAD 98 version 5.0.

Figures D.1. through D.4. show the thrust distribution plots for the UH-60A at HOGE and 115 knots with the Sc1095r8 and Sc1094r8 airfoils meshed at 0.80 r/R. As can be seen, the general curve follows that of the test flight data out to the "fish hook" in the twist distribution. Even the slight increase in thrust at the mesh point is evident. Since the radical change in structural twist occurs out near the tip where JANRAD's two dimensional theory and constant tip loss assumptions break down, and the twist is not modeled even in Sikorsky's models, the rest of the runs were made using the equivalent linear twist of –15 degrees. Figures D.3 through D.10 show UH-60A radial airload distributions at psi= 0, 90, 180 and 270 degrees for airspeeds of 0, 65, and 115 knots. Notice that the JANRAD 98 version 5.0 predicted results more closely matching those of the actual test data than do the previous calculations of Eccles (1995) in most cases. This is expected, if for no other reason than the use of actual UH-60A mach number dependant airfoil data instead of the single curve VR-12 data. Tip airloads are still not modeled very closely due to an inability to model the 3-D flow of the blade's swept tip.

3. Power Required vs. Airspeed

Figures E.1 through E.4 validate the power required curves of the UH-60A with JANRAD 98 version 5.0. Shown are traces of actual and predicted main rotor power versus airspeed for the UH-60A. In all cases, the helicopter is in straight and level flight. The flight conditions were obtained along with the actual test data from the TRENDS database. The primary differences from flight to flight are that the helicopter's gross

weight and the altitude at which the flights were flown both increased as the program progressed.

An important contribution of Eccles (1995) work was recognizing that flat plate areas had to also be adjusted to account for the automatic flight settings of the variable incidence horizontal stabilator on the UH-60A. In his work and the present work, it was important to compensate by adjusting the overall equivalent flat plate area input to the program.

Discussions with Sikorsky provided insight into realistic flat plate areas and horizontal tail forces versus airspeed. These assisted in producing reasonable results. This shows the sensitivity of the power required to small variations of flat plate area, and the importance of knowing accurately what the flat plate area of any given helicopter is at every flight condition. In the case of both the UH-60A Blackhawk and the AH-64A Apache helicopters, scale model tests were conducted in the NASA Langley low speed wind tunnel to obtain corresponding flat plate areas.

Limitations of up to ten percent in predicting power required below approximately 50 knots can be attributed to well understood approximations in programs such as JANRAD. The classic text by Gessow & Meyers (1952) cited the following as potential sources of error in hover performance prediction:

- Profile-drag losses
- Nonuniform inflow
- Slipstream rotation
- Tip losses

For the case of a preliminary design tool, the discrepancies between the JANRAD 98 version 5.0 results and the test flight data can be considered small. JANRAD 98

version 5.0 predicted values within approximately five percent throughout all runs, at varying altitudes, airspeeds, and temperatures. In order to increase the expected accuracy, significant changes to the JANRAD code would need to be made. These changes would increase the complexity and running time of the program, negating the primary reason it was designed; to provide a user friendly, preliminary design tool, based on industry accepted procedures and assumptions.

IV. CREATING STABILITY AND CONTROL GUI ARCHITECTURE

A. DESIGNING THE FRONT END

Utilizing the methods and lessons learned from development of the Performance Graphical User Interface (GUI), work was begun on the Stability and Control module of JANRAD 98 version 5.0. Section II of Lapacik's (1998) thesis outlines in detail the use of GUIDE ® to develop figure windows. The Stability and Control module required an additional 64 variable entries in order to calculate all of the pertinent stability derivatives. A structure containing the new input variables was created was saved into the existing data files. Two input screens, shown in Figures 12 and 13, were developed which contain descriptors and edit text boxes with all values displayed.

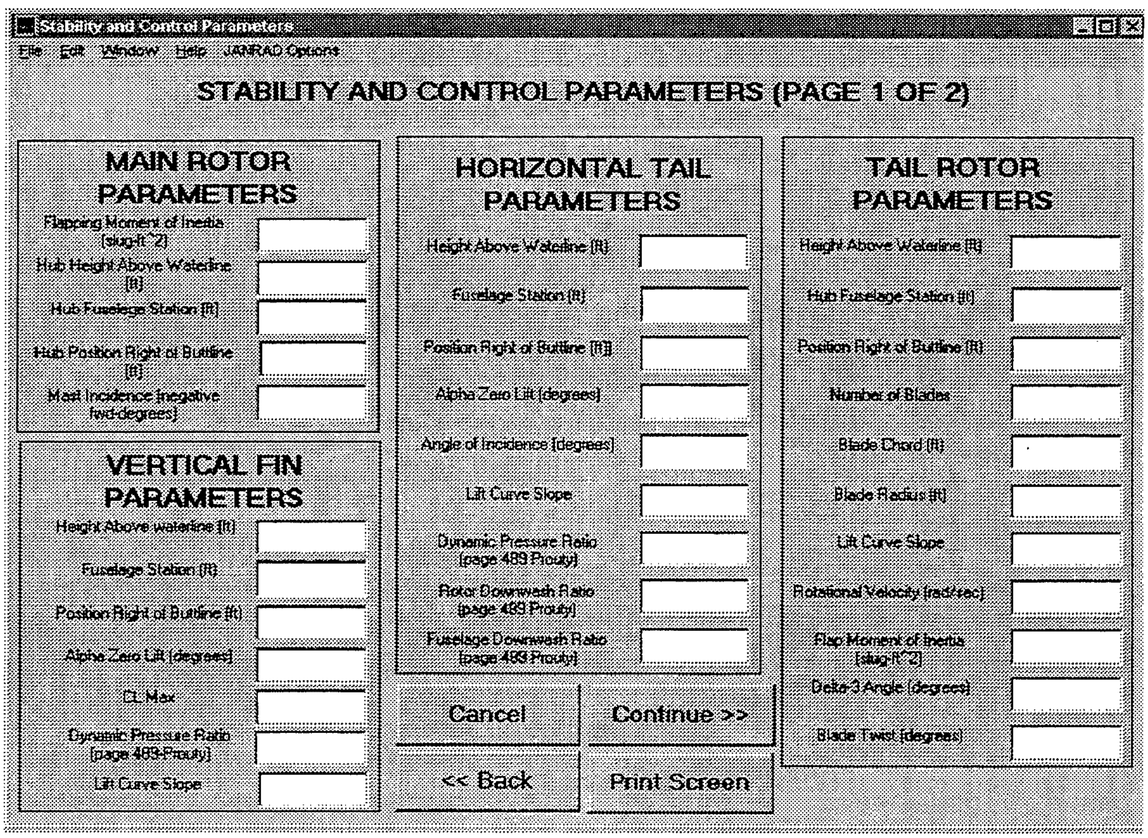


Figure 13. Stability and Control Input, Screen 1 of 2

These values are automatically loaded when a data file is selected at the beginning of the JANRAD 98 version 5.0 session. Even if the user elects to create a new input file instead of loading an existing one for the Performance module, the option will be given to load an existing file for the Stability and Control section due to the large number of variables which must be entered.

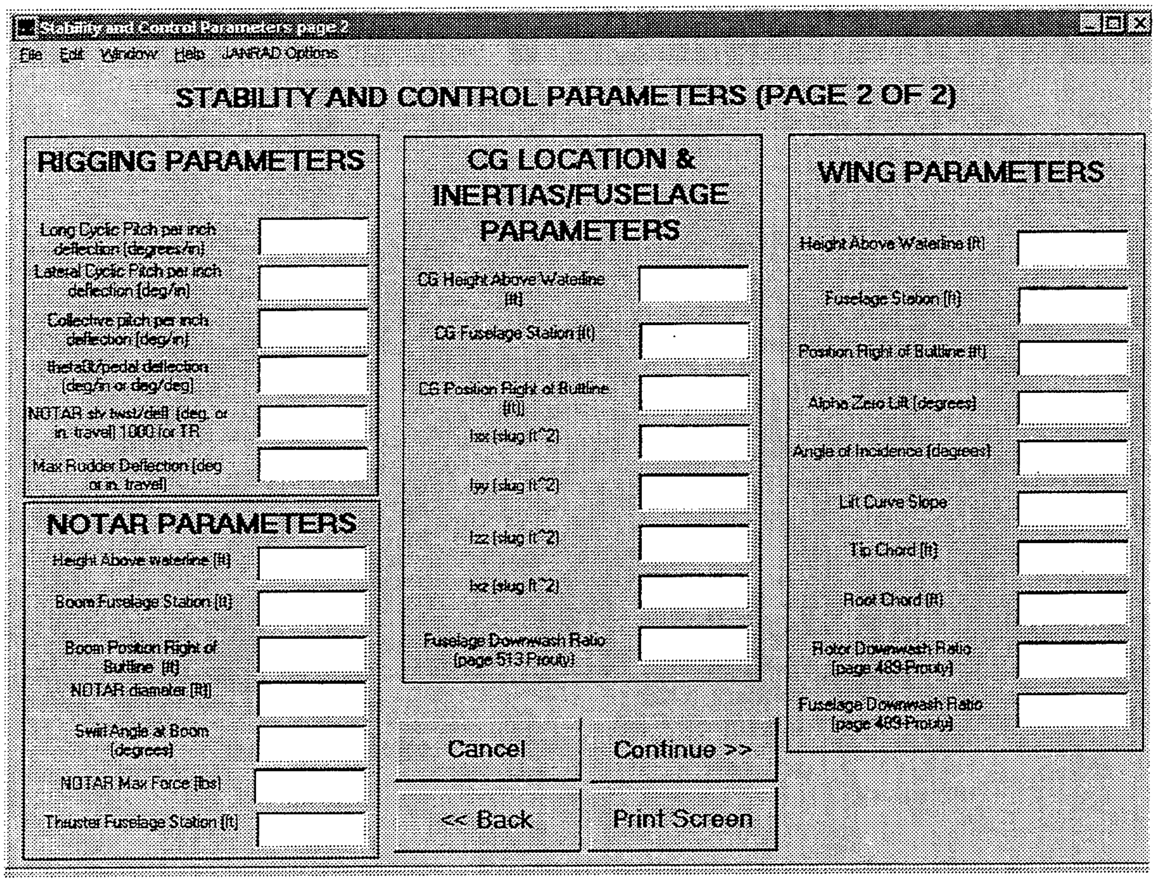


Figure 14. Stability and Control Input, Screen 2 of 2

The MATLAB® code for the input figures was automatically generated as the figures were created. Additional properties and Callbacks were added after initial development to adjust or create the properties and/or functions of the individual uicontrols. As was the case with the Performance module, only minor changes were

made to the MATLAB® code while tying it to the GUI by way of Callbacks and Switchyards.

B. CONNECTING THE BACKEND

As the file structure of JANRAD 98 version 5.0 continued to grow, keeping track of M-files and variables became increasingly difficult. For this reason, the conventions discussed in section III of Lapacik (1998) were strictly adhered to. Both file and variable name conventions were continued for the Stability and Control module. Switchyard Callbacks and Structures greatly assisted in simplifying the flow of the file structure as well as making it easier to debug mistakes when they occurred. The Structure capability was especially valuable due to the large number of stability and control variables needing to be passed among the various M-files.

C. ARCHITECTURE

The branch point for the Stability and Control module was previously programmed into the Performance module. Selecting *Stability and Control* on the welcome screen sets a switch which after completion of the performance calculation, takes the user to the Stability and Control input screens. From there, the GUI and Switchyard functions provide the necessary commands, variable creation/change, and execution of the additional script and function files to complete the Stability and Control analysis. If the *Stability and Control* option is selected after the performance calculations have been made, the user will be taken directly to the stability and control input screeens.

V. CONCLUSIONS

Working with JANRAD 98 version 5.0 has been an enlightening experience. A much better understanding of rotor blade performance, effects of cross sectional area on power required, and some of the limitations of certain assumptions has been gained. Through examination of different airfoils, the importance of rotor blade design geared toward an aircraft's performance envelope have become evident. We find that good rotor blade design is a compromise both between high and low-speed flight and between advancing and retreating sides of the rotor disk.

The spanwise airload plots in Appendix D provided a very good proof as to the accuracy of the JANRAD 98 version 5.0 output. Using the Sc1094r8 and Sc1095r8 meshed rotor blade provided spanwise airload distributions much closer to actual distributions than did those of Eccles' modeled VR-12 blade. Although the plots are better, the limitations of JANRAD's two dimensional assumptions of flow become evident out toward the blade tip. Here the three dimensional flow around the blade's swept tip cause variations that are not modeled in JANRAD. These tip effects are time dependent and their greatest influence is on predicting the time history of blade stresses.

JANRAD 98 version 5.0's power required numbers were found to be sensitive to the helicopter's equivalent flat plate area. Good performance calculations require that the user have a very good idea of actual aircraft flat plate areas for varying flight conditons. Once these values were determined accurately for the UH-60A, the power required numbers calculated by JANRAD 98 version 5.0 matched those of the test data very well. Discrepancies in hover power required values are largely due to the fidelity of predicting rotor downwash which depends upon modeling the rotor wake. As was first documented by Eccles (1995), there still exists some disparity in JANRAD 98 version 5.0's power required predictions and actual test data at altitudes higher than 8,000 – 10,000 feet. Discussions with Sikorsky revealed that the mach number corrections to the airfoil data

are not the only source of difference. A breakdown in the assumptions used to calculate power required tends to occur at combinations of high altitudes, high gross weight and high power settings that can explain these differences.

Implementation of code to deal with design of compound helicopters revealed two interesting phenomena. First, setting the tip path plane angle to some small angle, zero being the best, resulted in a significant decrease in rotor drag which allowed for power savings when using auxiliary propulsion at high speeds. Second, by removing a large percentage of lift from the rotor and placing it on a wing, rotor blade design became even more critical. The spanwise thrust distribution was altered which increased the local angle of attack seen by blade elements. In order to reach higher speeds, blade twist had to be decreased to offset this tendency.

VI. RECOMMENDATIONS

Since this thesis covered more than one area, the recommendations section will be broken into two specific areas: (1) Performance module recommendations; (2) Stability and Control module recommendations.

A. PERFORMANCE MODULE RECOMMENDATIONS

Many of the features added to the performance module are the result of recommendations made in other JANRAD theses. The following areas are suggested topics for future changes to this program. They are:

(1) The capability to offset the center of gravity from the center of the rotor hub during the rotor trimming process. Adding this capability would allow JANRAD to be used to:

- (a) Improve the capability to trim for varying horizontal tail parameters.
- (b) Explore the effect of center of gravity variations on rotor loads.

(2) Variable inflow at airspeeds above hover but less than 100 knots. This would help to more closely predict power required at these airspeeds. Due to the rotor wake, actual power required in this range is slightly greater than that calculated by JANRAD. Also, it would permit investigating vibrations from hover to 100 knots.

(3) A method of determining angle of attack of the wing on a compound helicopter to better model rotor downwash effects.

(4) Implement a free wake analysis to better model three dimensional and tip effects.

(5) Implement an interactive screen which diplays Cl and Cd plots vs airspeed to allow user to better select best airfoil to meet design requirements,

Additional recommendations for the Performance module are:

(1) Make changes to the JANRAD code which calculates the mean thrust location. This value, when allowed to wander far away from the 0.7 r/R assumed increases computation time and introduces innacuracies into output values.

(2) Incorporate a baseline test case as a diagnostic run. This would help validate JANRAD's code after it has had modifications done or has gone unused for an extended period of time.

(3) Talk to the helicopter manufacturers and government laboratories to ensure the input, such as equivalent flat plate area at different flight conditions, is accurate. This will pay large benefits in validation studies.

(4) Continue to use the upgraded capabilities of subsequent MATLAB® releases to improve the GUI operations.

(5) Continue to add airfoils in the C-81 format to the JANRAD library. This will increase the different types of helicopters which can be designed.

(6) Implement some sort of file or directory management to handle the

increasing size and complexity of the module as the GUI is made more complicated. This will become especially important as the Stability and Control, and the Dynamics modules are tied together with the Performance module.

(7) Integrate the variables for fan-in-tail and notar tail rotor types into the aircraft data files. Also add logic code in *Trim.m* to ensure the proper tail rotor calculations are completed.

(8) Automate compound helicopter parameters to allow for scheduling of percent of lift on wing, auxiliary thrust with airspeed, and tip path plane angle with airspeed.

B. STABILITY AND CONTROL MODULE RECOMMENDATIONS

This thesis involved only a limited amount of work to improve the Stability and Control module. The primary input screens were developed and tied into the existing code, but no upgraded capabilities were added. As this work is being continued in another thesis, the following goals should be of primary emphasis:

(1) Continue to develop GUI screens for other aspects of the module such as stability derivative outputs. Introduce file print capabilities and/or GUI screen print capabilities.

(2) Standardize the variable names between the Performance and the Stability and Control modules. These two modules were developed separately by the original authors and duplicate many variable names.

(3) Develop input data files for different aircraft. Due to the complexity of calculating many of the required input variables, work should be

done to document several different input files as references. These can be loaded and then modified as necessary, reducing the difficulty for the user.

(4) Examine and expand the output capabilities based upon improvements to current MATLAB® versions over older ones. This could include improved graphical outputs as well as simulink modeling and simulations.

APPENDIX A. JANRAD 98 USER'S GUIDE

The JANRAD 98 Users Guide is written as a brief introduction to the Joint Army/Navy Rotorcraft Analysis and Design computer program. It is intended to explain the basic features and operation of the program and assumes a basic knowledge of helicopter mechanics and the use of the MATLAB® programming language by The MathWorks® Inc.

A. SYSTEM REQUIREMENTS

JANRAD 98 requires MATLAB® version 5.0 or MATLAB Student Edition version 5.0 or higher. It will not run on any previous versions. JANRAD 98 version 5.0 will fit on a single 1.44 MB floppy disk and will need that much memory available for installation. JANRAD 98 requires only the hardware to support MATLAB® 5.

B. INSTALLATION

The recommended installation of JANRAD 98 is accomplished by first creating a subdirectory of MATLAB called Janrad98. The entire contents of the JANRAD 98 floppy disk should be copied into this directory. Include all M-files and .mat files. JANRAD 98 will not run without all of the .mat files.

It is recommended that this new subdirectory be added to the MATLAB 5 search path. This procedure will eliminate the need to change the working directory from the command line each time JANRAD 98 is run and allows you to work from a floppy disk if desired. Adding the subdirectory to the search path is accomplished by selecting *File*, *Set Path...* from the File menu. Change the current directory to the new Janrad98 subdirectory by using the *Browse* button. Then press the *Add to Path* push button. You will then be given the option to save the new path or just use the new path for the active

session. It is recommended to save this path. Figure A.1 shows the MATLAB® Path window.

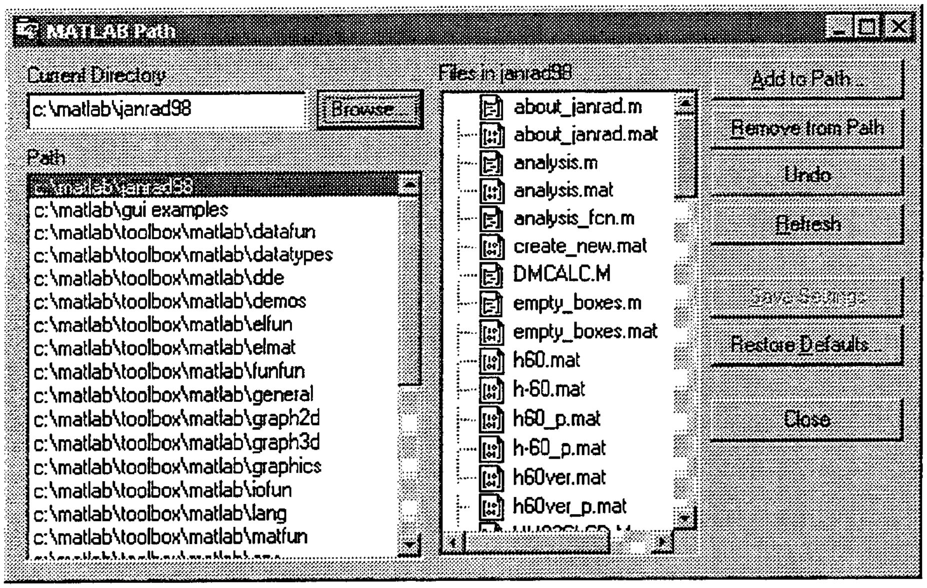


Figure A.1. MATLAB 5 Path Window.

C. STARTING JANRAD 98

Typing janrad98 (lowercase, one word) at the command line prompt of a current MATLAB session starts JANRAD 98. This action will launch the JANRAD 98 welcome window shown in Figure A.2.

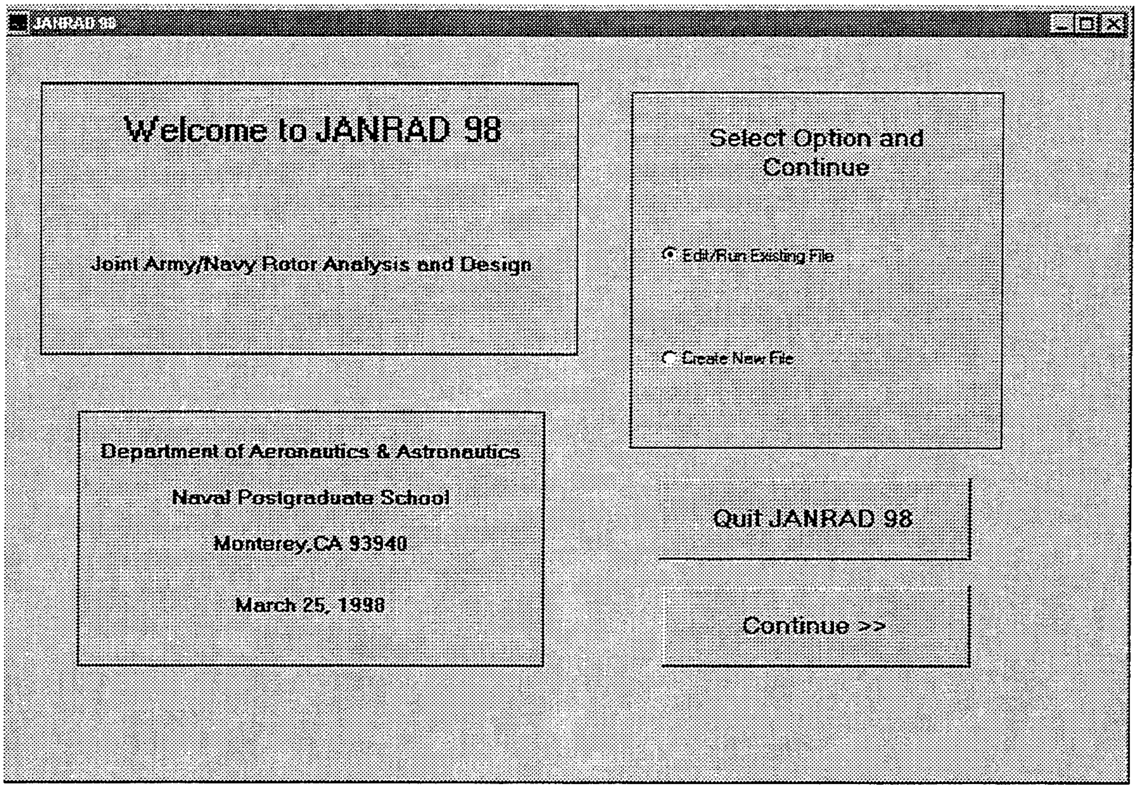


Figure A.2. JANRAD 98 Start Up Window.

D. USING JANRAD 98

As an example, the use of this program will be demonstrated by selecting a previously saved input data file and changing the weight, airspeed and pressure altitude. User defined blade elements and blade twist will be entered. Tail rotor parameters will be verified but not changed. The input and output files will be saved and printed. After the performance analysis is complete, we will then iterate on airspeed from 80 to 100 knots in increments of 5 knots.

First, from Figure A.2, select the Run/Edit Existing File radio button. It is usually easier to edit an existing file because Create New File will not give you the chance to change the working directory if desired. Once the selection has been made, press the *Continue* >> button.

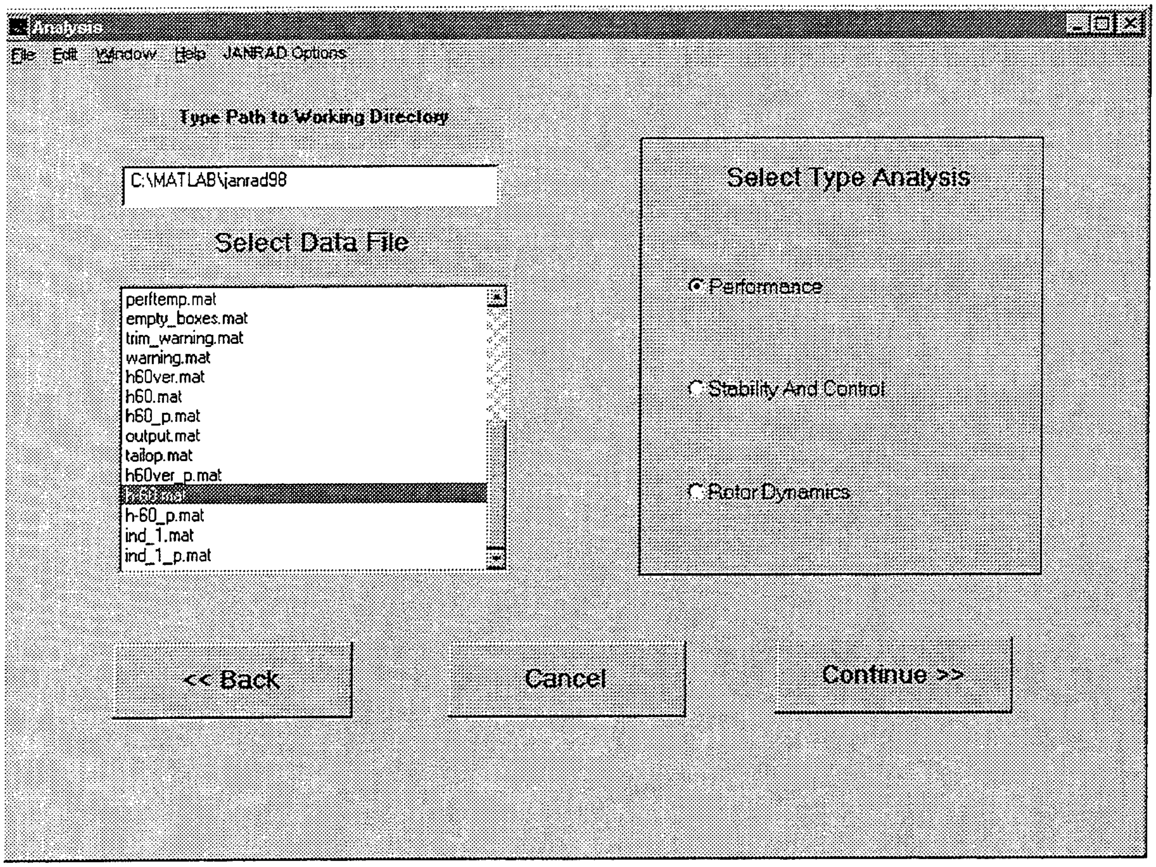


Figure A.3. Selecting a File to Edit.

The next figure window to appear is shown in Figure A.3. This window allows you to change the working directory and select an input data file. To change the directory, type or edit the desired path in the edit box. All of the .mat files listed in the working directory are displayed in the list box. Input data files are saved as *filename.mat*. A note of caution here, each GUI window also has an associated *guifilename.mat* file. The user should name input/output data files using helicopter aircraft designations such as UH-60A, h-99 or h-design1 to differentiate from JANRAD 98 GUI files. Next, select an input file to edit by clicking on the file name. For this example, we will edit the UH-60A.mat file. Then press *Continue* >>.

The Performance Input window will be displayed as in Figure A.4. The input data will be displayed within the appropriate edit boxes. Any or all of the parameters can be changed at this point without altering the original data file. You will have the opportunity to save the new data if you chose after the analysis has been completed.

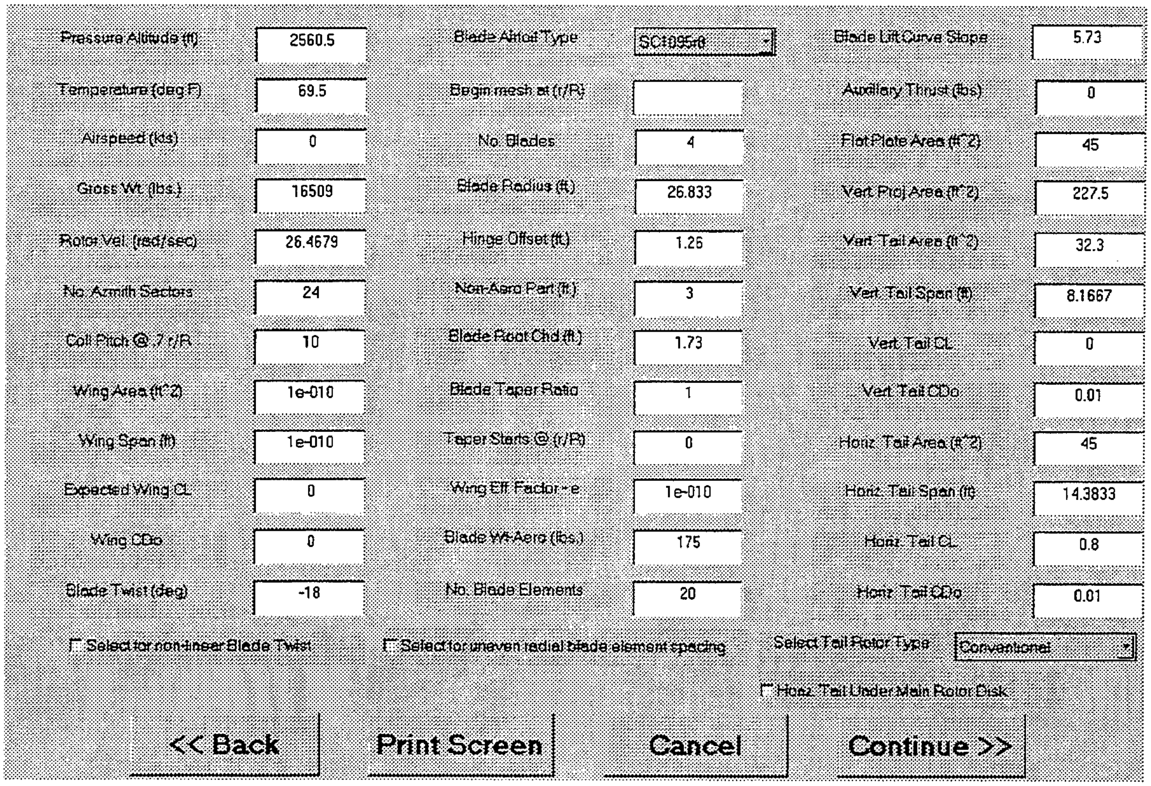


Figure A.4. Performance Input Parameters

The airspeed, weight and pressure altitude can be edited by highlighting and typing 100, 17,000 and 2,000 in the respective edit boxes. Pressing the enter key is not necessary to enter the new value. Using the Tab key or clicking on another edit box or control will enter any changes. If the user wishes to mesh airfoils, click the Blade Airfoil Type scroll bar, and select *Airfoil_Mesh*. The Begin Mesh at (r/R) box will be enabled and a value may be entered. At this point, select both the non-linear blade twist and

uneven blade element spacing blocks. Note that the blade twist and number of blade element boxes are disabled. The Print Screen button will print a draft copy of the GUI window with the displayed values if desired. It however, will not record the file name for which the values are stored. Now press the *Continue* >> button.

From the Performance Input window, JANRAD 98 will call the Compound Helicopter and Tail Rotor Parameters window, Figure A.5. In our example we are dealing with a conventional helicopter, therefore no wing or auxiliary thrust is present. We do, however, need to verify the tail rotor parameters which have been either loaded from the data file or calculated. The parameters will be entered in the appropriate tail rotor type. Press *OK* when ready to continue.

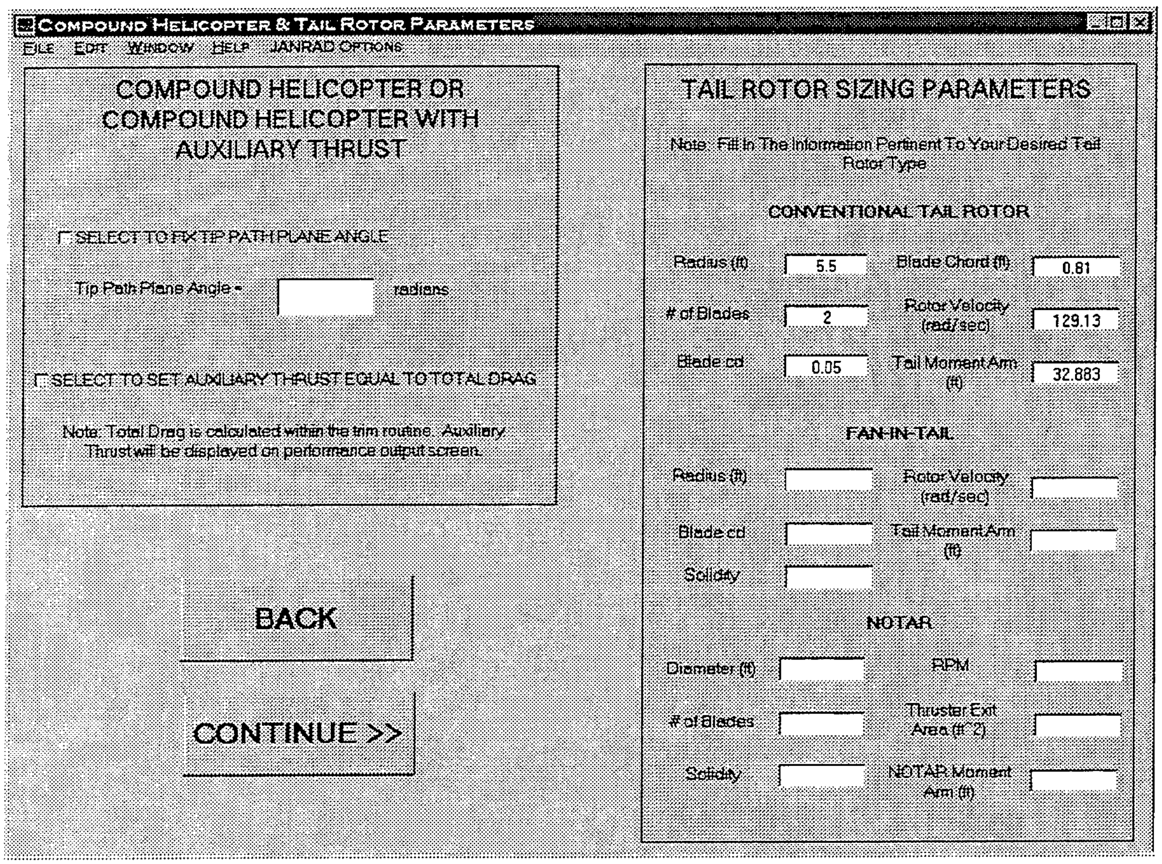


Figure A.5. Enter Compound Helicopter and Tail Rotor Parameters

With either non-linear blade twist or uneven blade element spacing selected, JANRAD 98 will next go to the Blade Element page, shown in Figure A.6.

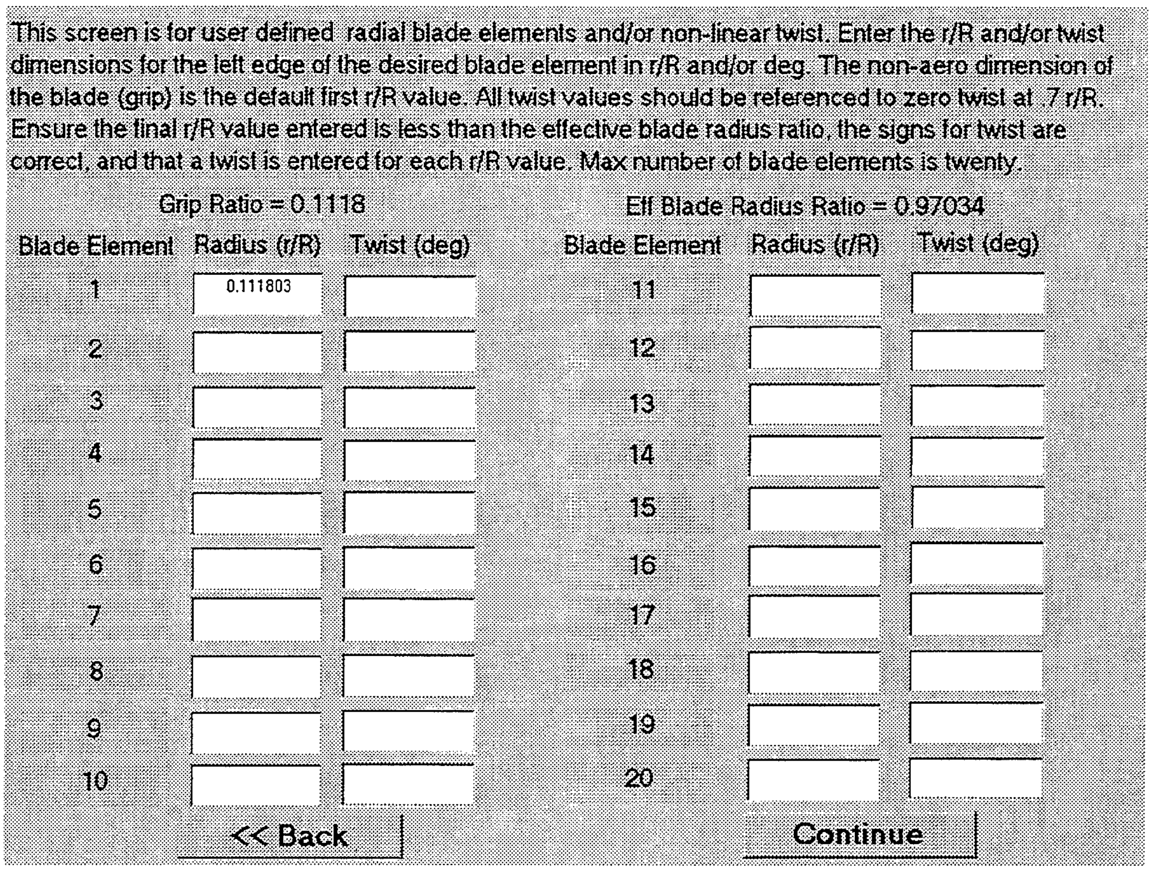


Figure A.6. Enter Uneven Blade Elements & Non-linear Blade Twist

The grip ratio contained in the loaded data file will automatically be displayed along with the effective blade radius. The user can enter up to twenty blade elements and the corresponding twists. **IMPORTANT!** Ensure dimensions are entered to the left edge of the blade element from the blade root. JANRAD98 will automatically calculate the values at the center of the blade elements. Also, do not enter any value greater than the effective blade radius or an error message will appear. After entering the desired values press *Continue*.

Next, JANRAD 98 will call the Iteration Method window as shown in Figure A.7.

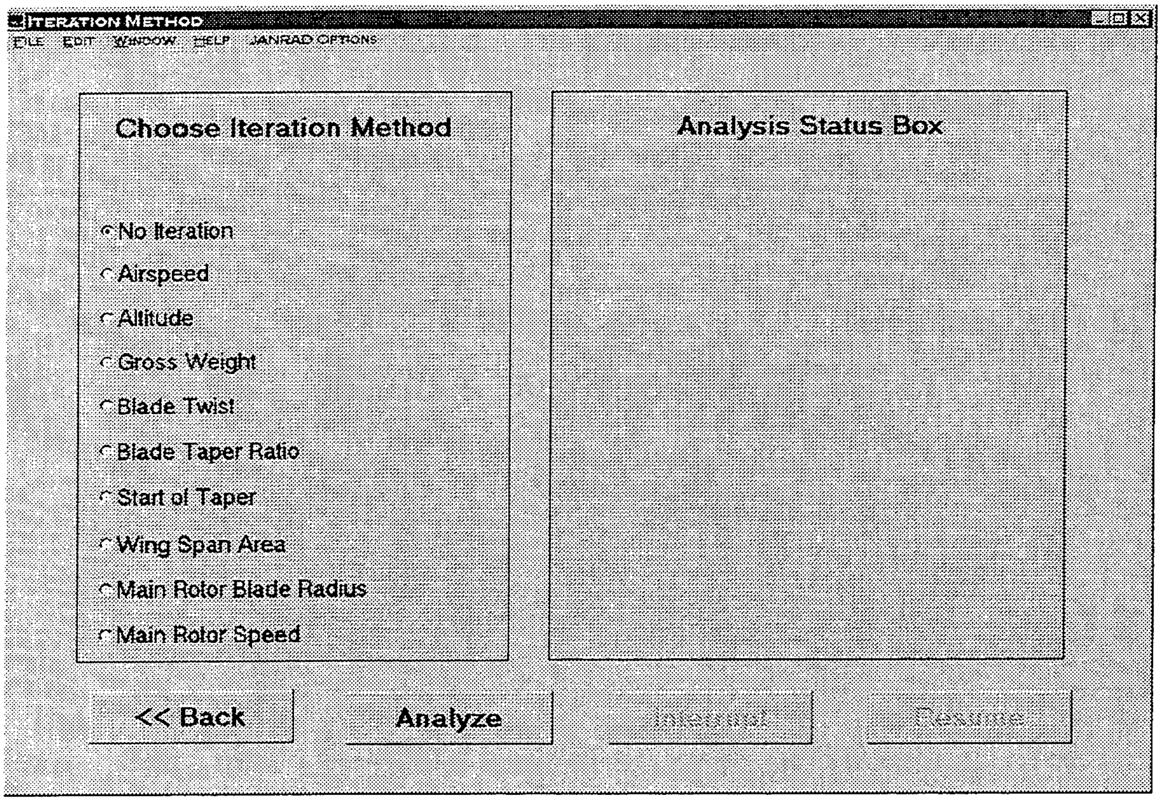


Figure A.7. Iteration Method / Analysis Window.

JANRAD 98 will call its computational routines from this window. By choosing *No Iteration* and *Analyze*, JANRAD 98 will run the parameters selected from the previous window. The *Analyze* pushbutton initiates the computational routines. All controls on the GUI will be disabled except the Interrupt pushbutton. The Analysis Status Box will display the performance routine status, clock, iteration number, and iteration parameter value as JANRAD trims the rotor and adjusts the collective and cyclic mathematically. The Interrupt button will halt the routine and enable the Resume control and JANRAD Options menu on the GUI. This will allow the user to change parameters, quit or return to beginning. The Resume button will continue with the performance routine where it originally interrupted. It is worth noting that the Interrupt button will not

always respond immediately. However, once MATLAB finishes its current line evaluation, the calculation will pause.

The Status Box will inform the user when calculations are complete. The Performance Output window will be displayed automatically. The Performance Output window shown in Figure A.8 displays the performance results. These results can be saved and the screen printed from this window. However, it is recommended to print the saved input and output files through the next window. By pressing the *Options* >> push button, the saved input and output files can be printed simultaneously and in a more usable format. The input/output files can be saved after activating the checkboxes, typing a file name and pressing the *Save* or the *Options* >> push buttons.

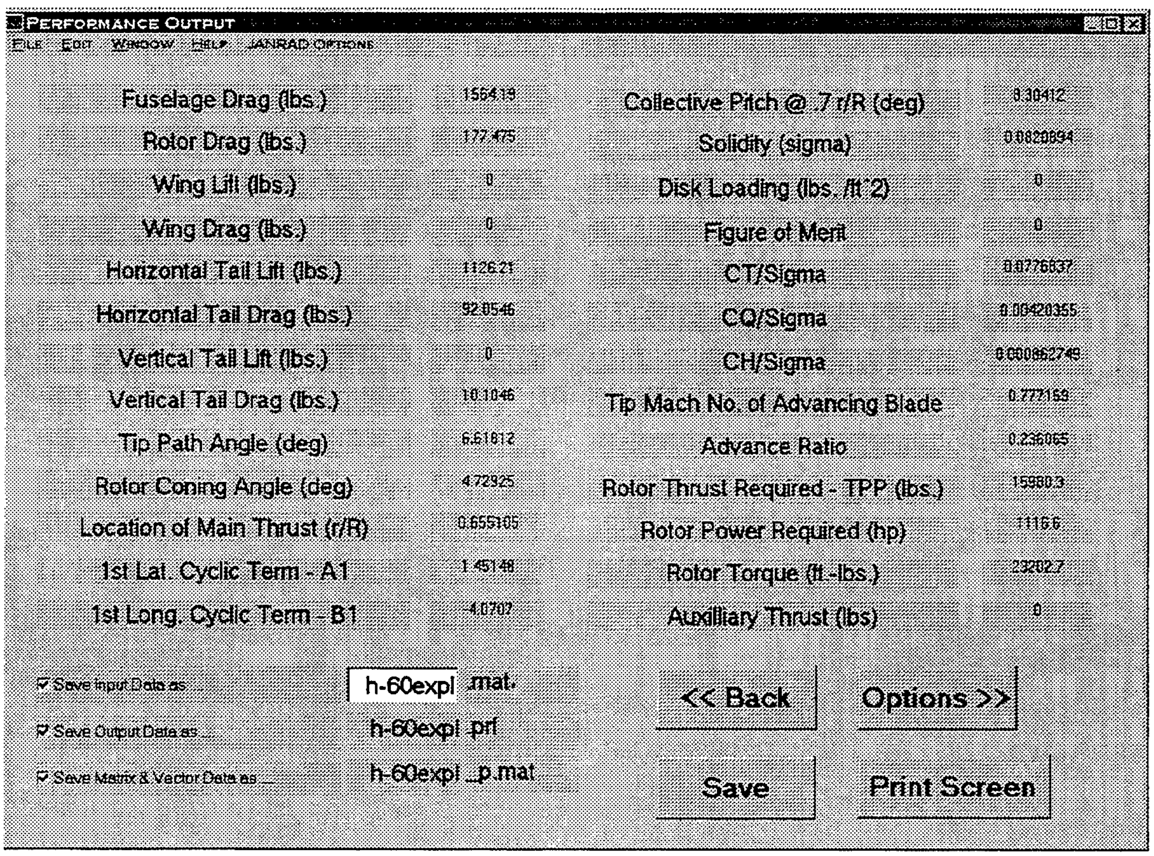


Figure A.8. Performance Output Window.

The Options window in Figure A.9 provides the capability to print the latest files, go to create plots screens, and eventually, select additional analysis routines. At this time however, the Stability and Control and Rotor Dynamics routines have not been completed. If selected, you will be reminded of this limitation.

From here, we will go back to calculate performance parameters by varying airspeed. This is done by pressing the *Change Iteration Method* radio button and the *Continue* >> push button. This will go back to Figure A.7. To vary airspeed, press the *Airspeed* radio button and then *Analyze*.

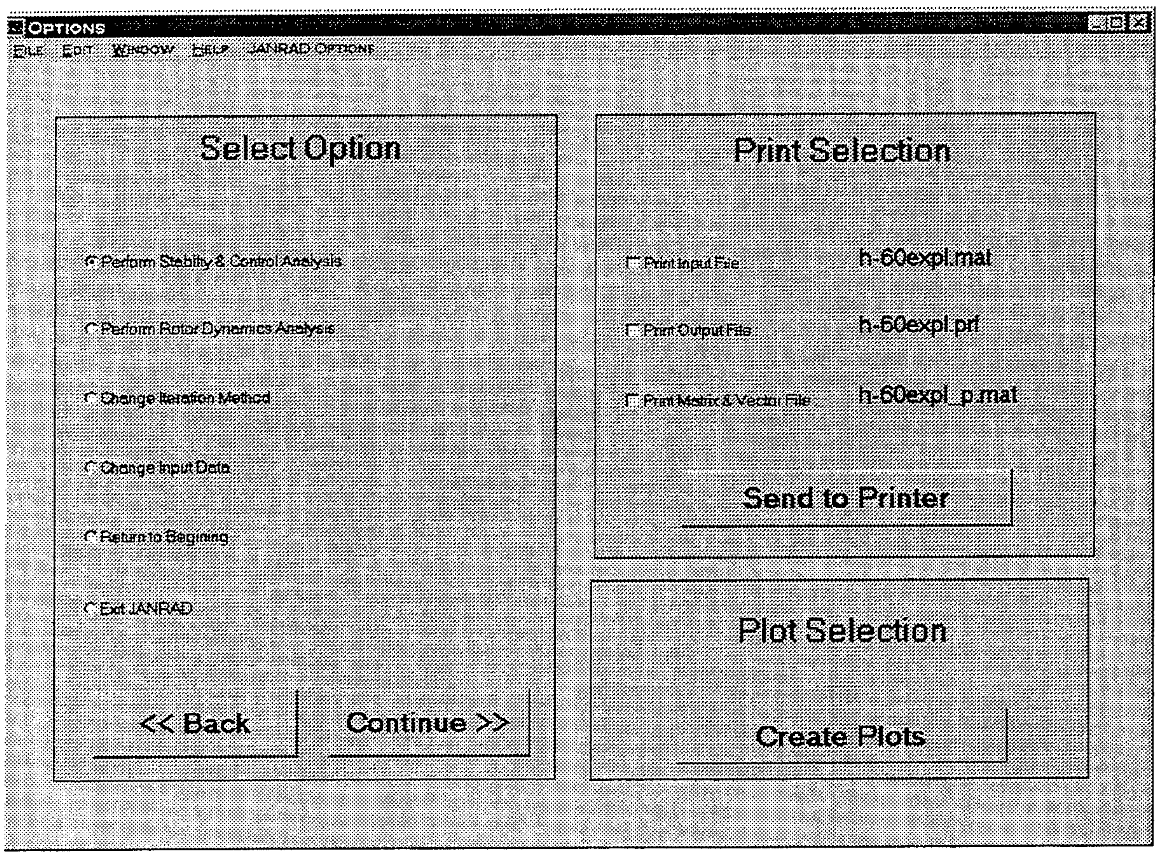


Figure A.9. Options Window.

Figure A.10 shows the Iteration Parameters window. By typing 80, 100 and 5 in the appropriate edit boxes and selecting *Analyze*, the performance routine will calculate various performance results with respect to airspeed. Later, the user will be able to create plots of many of these output parameters. Note: the *Aspect Ratio* edit box and *HIGE* check box are only enabled when *Altitude Iteration* or *Wing Span Area* is selected.

Figure A.11 shows the Create Plots screen for the Airspeed iteration method. Any or all of the plots may be selected. The plots are created and minimized as JANRAD automatically recalls the Options window, Figure A.8. Each iteration method has its own create plots screen. Some plots require additional user input prior to creating them.

Figure A.12 shows an example airspeed iteration subplot. These plots are primarily used to examine trade off studies during the design process.

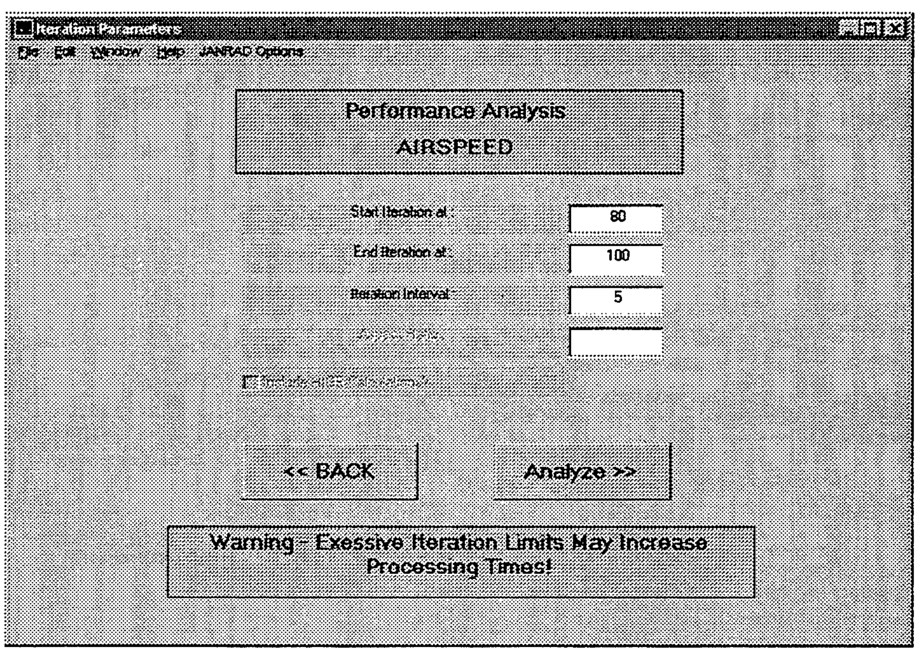


Figure A.10. Iterations Parameter Window.

The M-file create_plots.m contains the code for all of the iteration method create plot screens. If any additional plots are desired, changes can be made to this file. However, the plots should be substituted for those plots already existing, and the existing code should be commented out, not removed. Adding plots requires changes to multiple files for proper operation and should not normally be attempted. Always document changes made to the code for future users.

E. HINTS FOR JANRAD 98 OPERATIONS

The following paragraphs list some recommendations for the most efficient use of JANRAD 98. They are a guide based on observation, experience and knowledge of the code. Any other recommendations should be addressed to the Helicopter Design Instructor at the Naval Postgraduate School for implementation into the next version of JANRAD 98.

JANRAD 98 was designed for robust operations. However, because this is the first version to utilize a Graphical User Interface, not all cases of user inputs have been exercised. If the program appears not to be working properly, quit JANRAD using the options menu available on all but the first window. This action will quit JANRAD, close all MATLAB figure windows and clear the base workspace. Restart JANRAD by typing janrad98 at the command line.

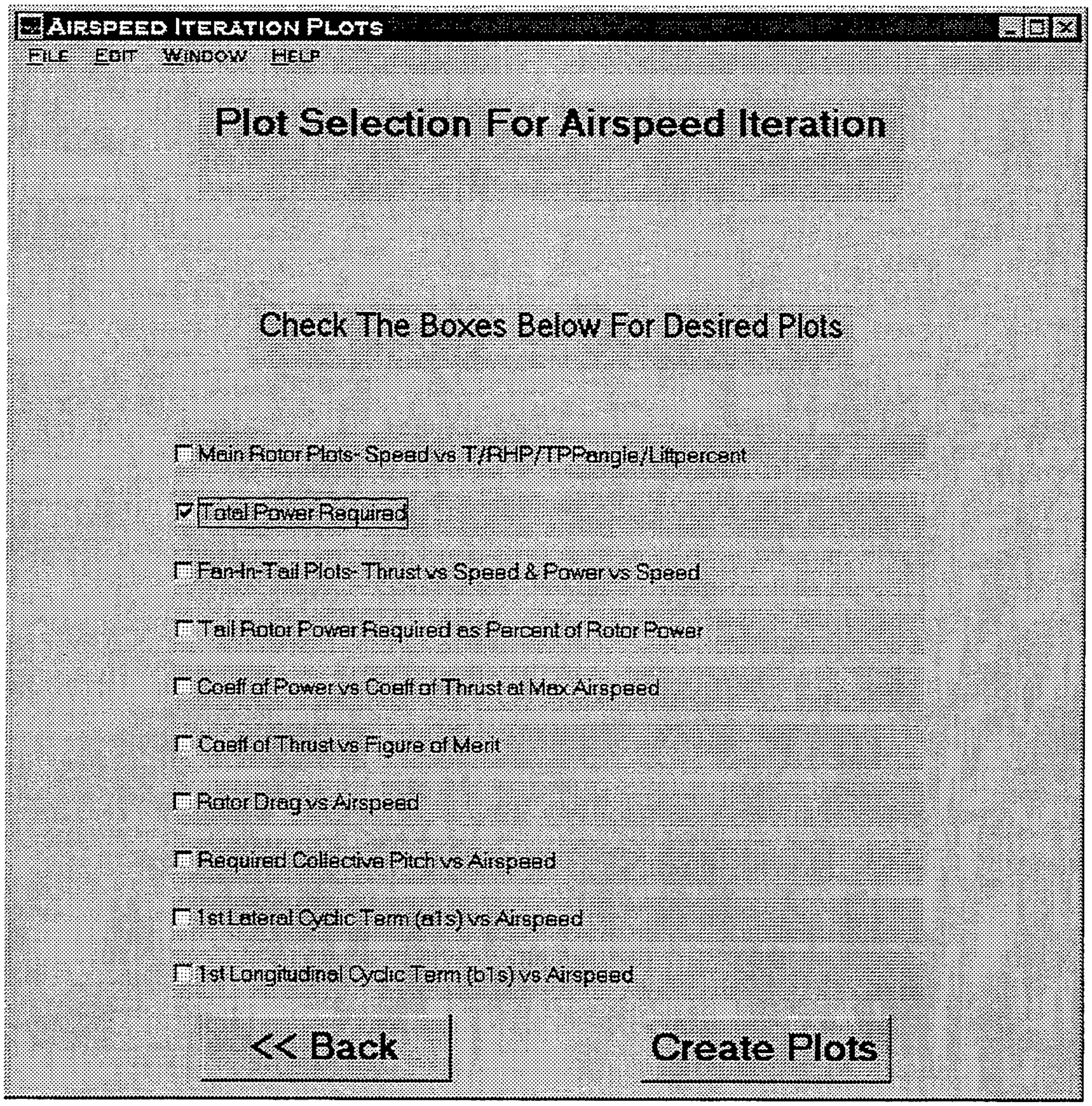


Figure A.11. Example Iteration Method Create Plot Window

Using azimuth sectors greater than 24 and blade elements greater than 20 will increase computation time. The accuracy of the results does not improve a significant amount for these larger values. However, if the 3-D plot from the No Iteration create plot screen is desired, 72 azimuth sectors will be required to give the proper resolution to the plot.

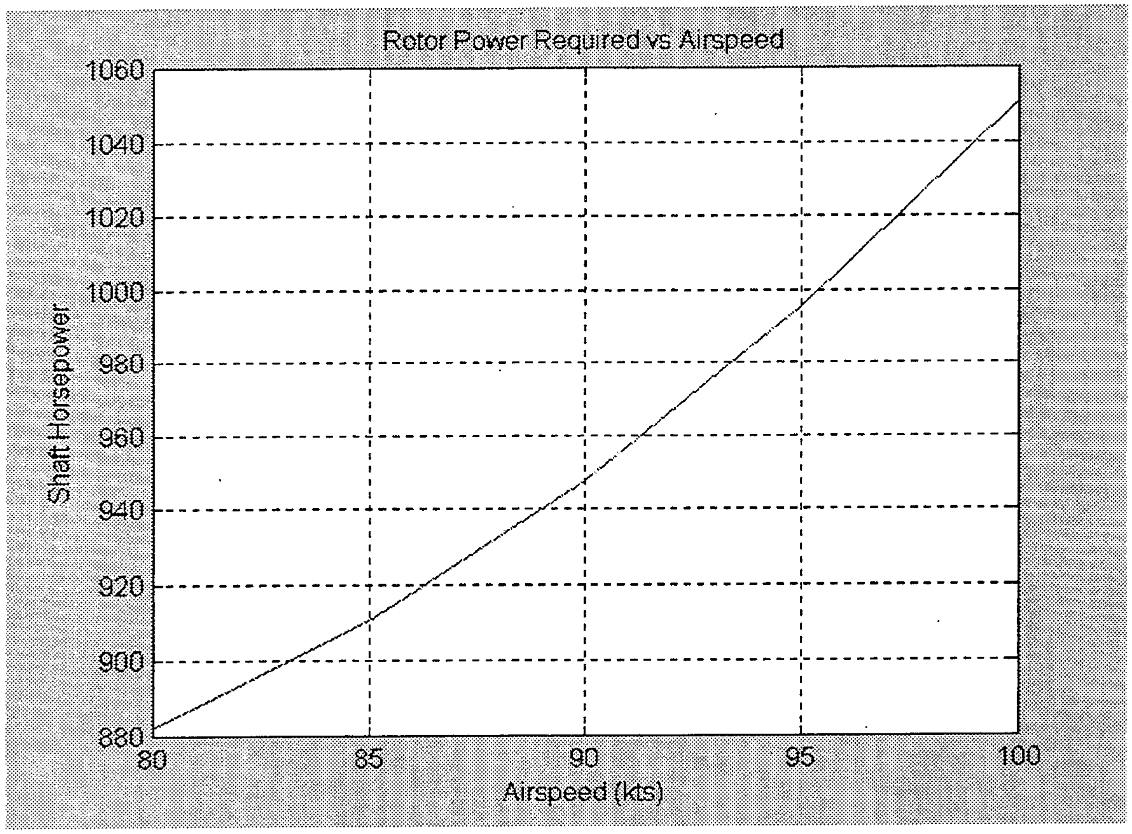


Figure A.12. Example of Airspeed Iteration Output Plot.

For more accurate results, use VR-12, VR-15, 0012, Sc1094r8 or Sc1095r8 airfoils when possible. These airfoils include Mach number inputs for CL and CD calculations. The HH-02 does not depend on Mach number. Note: VR-15 and Sc1094r8 airfoils are designed for use at the tips of blades and not for use along the entire blade. Faulty results should be expected when using them for that purpose.

Using the print screen buttons on the performance input or performance output windows will take up to several minutes on older processors. Use the Send to Printer button on the JANRAD 98 Options page for faster and more compact printer output.

APPENDIX B. VARIABLE_LIST.M

This script M-file contains a list of variables used in JANRAD 98 version 5.0. The list is broken up into four parts. The first part lists variables used primarily for computation and analysis. Then global variables, structure variables and GUI graphic handles are listed.

```
% This File lists the Variables used in JANRAD 98 Version 5.0

% Computational Vars.

% a        lift curve slope of rotor system airfoil
% Adisk    area of rotor disk
% Afh      fuselage equivalent flat plate drag area
% Afv      vertical projected area (fuselage area under disk)
% afoil    rotor system airfoil type (HH02/VR12)
% alpha    angle of attack, rotor blade radial segment
% alphaT   rotor tip path plane angle
% b        number of rotor blades
% B        tip loss parameter
% betao    rotor coning angle
% betat    geometric angle, rotor blade radial segment
% bhoriz   span, horizontal tail
% bvert    span, vertical tail
% bwing    span, wing
% cblade   chord, rotor blade
% CD       drag coefficient, rotor blade radial segment
% CDohoriz profile drag coefficient, horizontal tail
% CDovert  profile drag coefficient, vertical tail
% CDowing  profile drag coefficient, wing
% CDhoriz  drag coefficient, horizontal tail
% CDvert   drag coefficient, vertical tail
% CDwing   drag coefficient, wing
% CH       rotor H-force coefficient
% CH_sig   CH/solidity
% CL       lift coefficient, rotor blade radial segment
% CLhoriz  lift coefficient, horizontal tail
% CLvert   lift coefficient, vertical tail
% CLwing   lift coefficient, wing
% CON_b      Conventional tail rotor # of blades
% CON_cdo    Conventional tail rotor cd0
% CON_lt     Conventional tail rotor moment arm
% CON_omega  Conventional tail rotor speed
% CON_R      conventional tail rotor radius
% CQ       rotor torque coefficient
% CQ_sig   CQ/solidity
```

```
% CT        rotor thrust coefficient
% CT_sig    CT/solidity
% dD        differential drag, rotor blade radial segment
% ddD       differential drag, rotor blade tip
% ddDM      differential drag moment, rotor blade tip
% ddM       differential thrust moment, rotor blade tip
% ddT       differential thrust, rotor blade tip
% delM      change in total thrust moment
% Dftotal   resultant of fuselage drag and aux thrust
% Dfuse     total drag generated by non-rotor bodies
% DL        disk loading
% dM        differential thrust moment, rotor blade radial seg
% DMpsi     total blade drag moment at specific azimuth angle
% dr        rotor blade radial segment width
% Drotor    rotor system drag
% dT        differential thrust, rotor blade radial segment
% Dhoriz    drag, horizontal tail
% dthetadM  change in cyclic pitch with change in thrust moment
% Dvert     drag, vertical tail
% Dwing     drag, wing
% e         effective hinge offset
% ewing     wing efficiency factor
% filename  name of input file
%  filename3   name of file used in plot routines
% FM        figure of merit
% grip      length of inner non-aerodynamic portion of blade
% GW        aircraft gross weight
% Hrotor    rotor H-force
% lamdaT    forward flight induced velocity parameter
% Lftotal   total lift generated by non-rotor bodies
% Lhoriz    lift, horizontal tail
% Lvert     lift, vertical tail
% Lwing     lift, wing
% M1c       first harmonic (cosine) thrust moment coefficient
% M1s       first harmonic (sine) thrust moment coefficient
% Machtip   Mach number at rotor blade tip
% mblade    mass of rotor blade
% Mpsi      total blade thrust moment at specific azimuth angle
% mu        advance ratio
% naz       number of azimuth sectors
% nbe       number of blade elements
% omega     rotor rotational velocity
% PA        pressure altitude
% phi       inflow angle, rotor blade radial segment
% phitip    inflow angle, rotor blade tip
% Protor    power required by rotor
% psi       azimuth angle
% q         dynamic pressure
% Qrotor    rotor torque
% r         radius, rotor blade radial segment
% R         rotor blade radius
% Rbar      Reff-e
% RbarT     rT*Rbar
```

% Reff effective rotor blade radius (tip loss)
% rho ambient air density
% rT location of resultant thrust vector
% solidity solidity
% Shoriz area, horizontal tail
% Svert area, vertical tail
% Swing area, wing
% T rotor thrust
% tailrot value corresponding to type of tail rotor
% Taux auxiliary thrust
% temp ambient air temperature
% theta cyclic pitch
% theta1c first harmonic (cosine) of cyclic pitch
% theta1s first harmonic (sine) of cyclic pitch
% thetao collective pitch at .7 r/R
% Tpsi total blade thrust at specific azimuth angle
% tr rotor blade taper ratio
% twist geometric rotor blade twist
% Up vertical component of velocity
% Uptip vertical component of velocity at tip
% Ut horizontal component of velocity
% Uttip horizontal component of velocity at tip
% vi induced velocity
% Vinf forward airspeed
% Vtip tip speed
% wblade weight of rotor blade

% Global Vars.

% AF_MAIN Main airfoil in meshed airfoil
% AF_TIP Tip airfoil in meshed airfoil
% AR Aspect Ratio
% COUNT Counter to determine where Performance Input was called
% FIX_TPP_VAL Selected value for setting TPP to defined value
% INTER Iteration Interval
% MAXUM Iteration End Value
% MESH_VAL Selected value when airfoil mesh option chosen
% MESH_STA r/R station where mesh occurs
% MINUM Iteration Start Value
% NAME Input .mat file name
% NEW_AUX_VAL Value of auxiliary thrust
% NEW_r Vector of user defined blade elements
% NEW_TPP Value (rads) TPP is set to for compound helo
% NL_TWIST User defined twist vector
% NL_TWIST_VAL Selected value for non-linear twist
% OUT_COUNT Used to enable selection of plot routines
% PICK Iteration Method Choice (1-9)
% PLOT_VALS Values chosen for no iteration plot
% RADSPC_VAL Selected value for non-even blade elements
% REGIME Include HIGE Calculations Choice (1=yes, 0=no)

```
%   Structure Vars.

%   S_MATR_VEC          Matrix/Vector structure
%   S_PERF_INPUT        Perf.m input structure
%   S_USER_INPUT        User input structure
%   S_FIT_TR_INPUT      Fan-In-Tail input structure
%   S_NOTAR_TR_INPUT    NOTAR input structure


%   Graphics Handle Vars.

%   H_AF_MESH           Airfoil Mesh List Box
%   H_AL                Altitude Iteration Radio Button
%   H_AL_IT_P#          Altitude Iteration Plots
%   H_ANAL              Analysis Figure Window
%   H_AS                Airspeed Iteration Radio Button
%   H_AS_IT_P#          Airspeed Iteration Plots
%   H_ASPECT            Aspect Ratio Static Text Box
%   H_ASPECT_EDIT       Aspect Ratio Edit Text Box
%   H_BLD_EL            Blade Element Menu Handle
%   H_BK                Iteration Method << Back Push Button
%   H_BT                Blade Twist Iteration Radio Button
%   H_BT_IT_P#          Blade Twist Iteration Plots
%   H_BTR               Blade Taper Ratio Iteration Radio Button
%   H_BTR_IT_P#         Blade Taper Ratio Iteration Plots
%   H_check1            Save Input Data Check box
%   H_check2            Save Output Data Check box
%   H_check3            Save Matrix & Vector Data Check box
%   H_CID               Change Input Data Radio Button
%   H_CIM               Change Iteration Method Radio Button
%   H_CNF               Create New Radio Button
% H_datain              Save Input Data Edit Box
%   H_dataout           Save Output Data Edit Box
%   H_DISK              Horiz. Tail Under Main Rotor Disk Check Box
%   H_EJANRAD           Exit JANRAD Radio Button
%   H_EREF              Edit/Run Existing File Radio Button
%   H_FIX_TPP           Set TPP Check Box
%   H_GO                Analyze Push Button
%   H_GW                Gross Weight Iteration Radio Button
%   H_GW_IT_P#          Gross Weight Iteration Plots
%   H_HIGE              Iteration Parameters HIGE Check box
%   H_inputfile         Input File Static Text box
%   H_IP                Iteration Parameters figure window
%   H_IT_BOX            Iteration Parameters Static Text Box
%   H_IT_METH           Iteration Method figure window
%   H_JAN               JANRAD 98 Figure window
%   H_LB                Input File List Box
%   H_MEN               JANRAD 98 Options Menu handle
%   H_MESH              Mesh Parameters figure window
%   H_NI                No Iteration Radio Button
%   H_NO_IT_P#          No Iteration Plots
%   H_NL_TWIST          Non-linear twist check box
```

```
%  h_opt              Performance Output JANRAD Options Menu
%  H_OPTIONS          Options Figure Window
%  H_outputfile Output File Static Text box
%  H_P             Performace Radio Button
%  H_POP              Airfoil List Box
%  H_PERF_IN       Performance Input Figure Window
%  H_PERF_OUT         Performance Output Figure Window
%  H_PRDA             Perform Rotor Dynamics Radio Button
% H_printin     Print Input File Check Box
%  H_printout      Print Output File Check Box
%  H_printvec      Print Matrix & Vector File Check Box
%  H_PSCA             Perform Stability and Control Radio Button
%  H_RBR_IT_P#        Rotor Radius Iteration plots
%  H_RBS_IT_P#        Rotor Speed Iteration plots
%  H_RD               Rotor Dynamics Radio Button
%  H_RES              Resume Push Button
%  H_RTB              Return to Beginning Radio Button
%  H_RUPT             Interrupt Push Button
%  H_SAC              Stability and Control Radio Button
%  H_SOT              Start of Taper Iteration Radio Button
%  H_SOT_IT_P#        Start of Taper Iteration Plots
%  H_STATUS           Top Analysis Status Static Text Box
%  H_STATUS1          Middle Analysis Status Static Text Box (Elapsed Time)
%  H_STATUS2          Middle Analysis Status Static Text Box (iteration #)
%  H_STATUS3          Bottom Analysis Status Static Text Box (param value)
%  H_vecdata       Save Matrix & Vector Data Edit Box
%  H_vecfile       Vector File Static Text box
%  H_WORK             Working Directory Edit Box
%  H_WSA              Wing Span Area Iteration Radio Button
%  H_WSA_IT_P#        Wing Span Area Iteration Plots
```

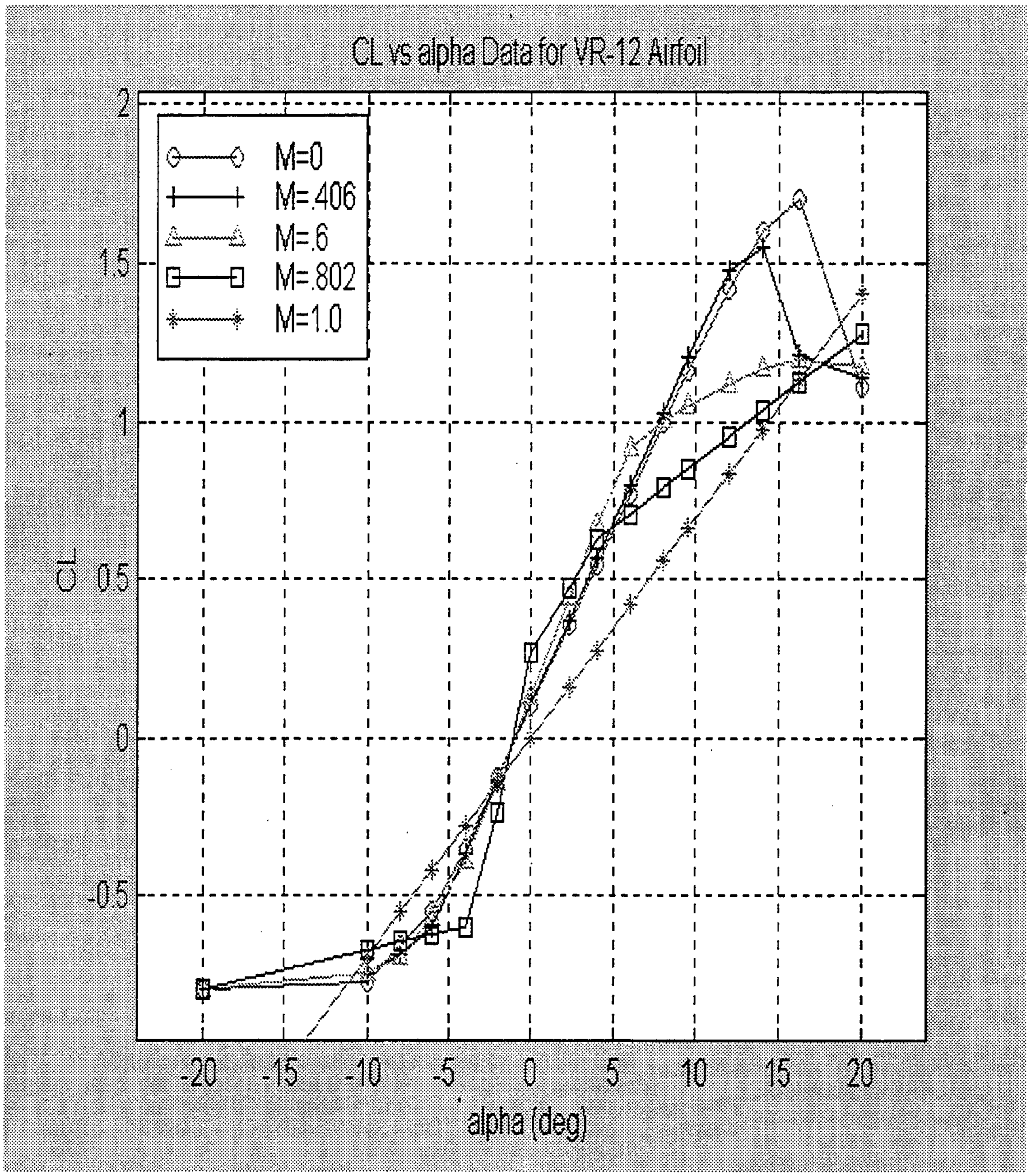


Figure C.1. VR-12 Cl Curve, Mach # Dependent

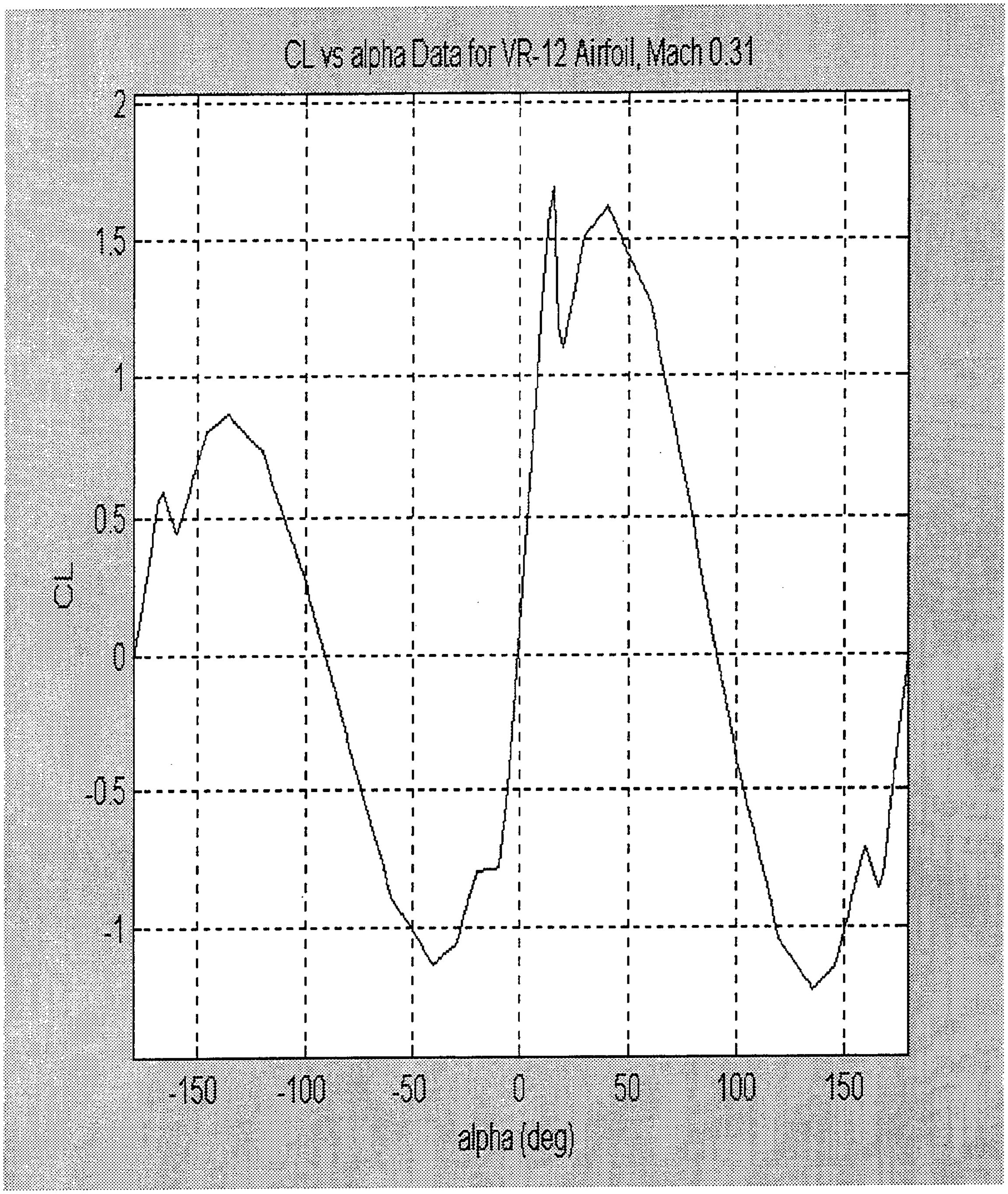


Figure C.2. VR-12 Cl Curve

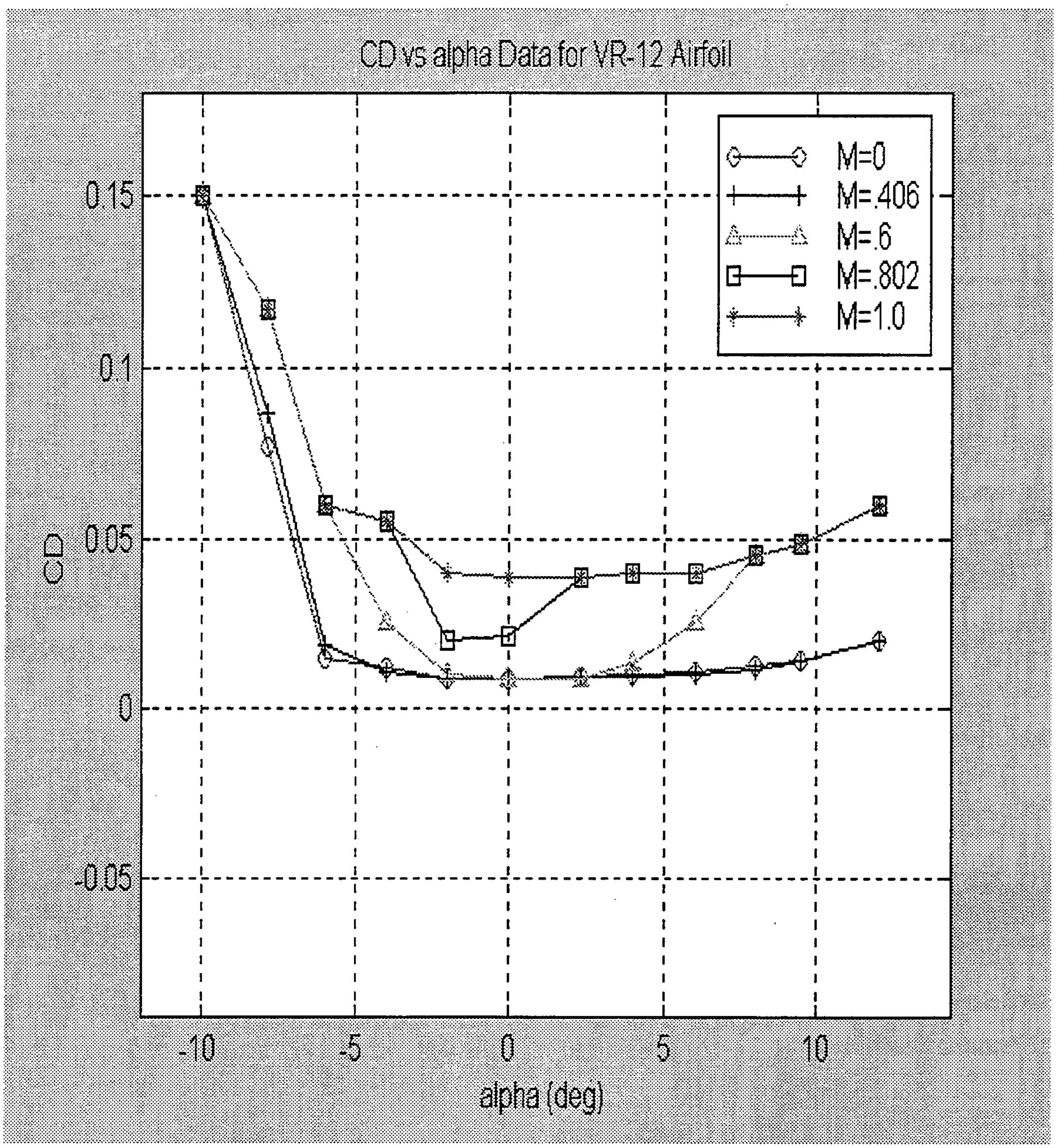


Figure C.3. VR-12 Cd Curve, Mach # Dependent

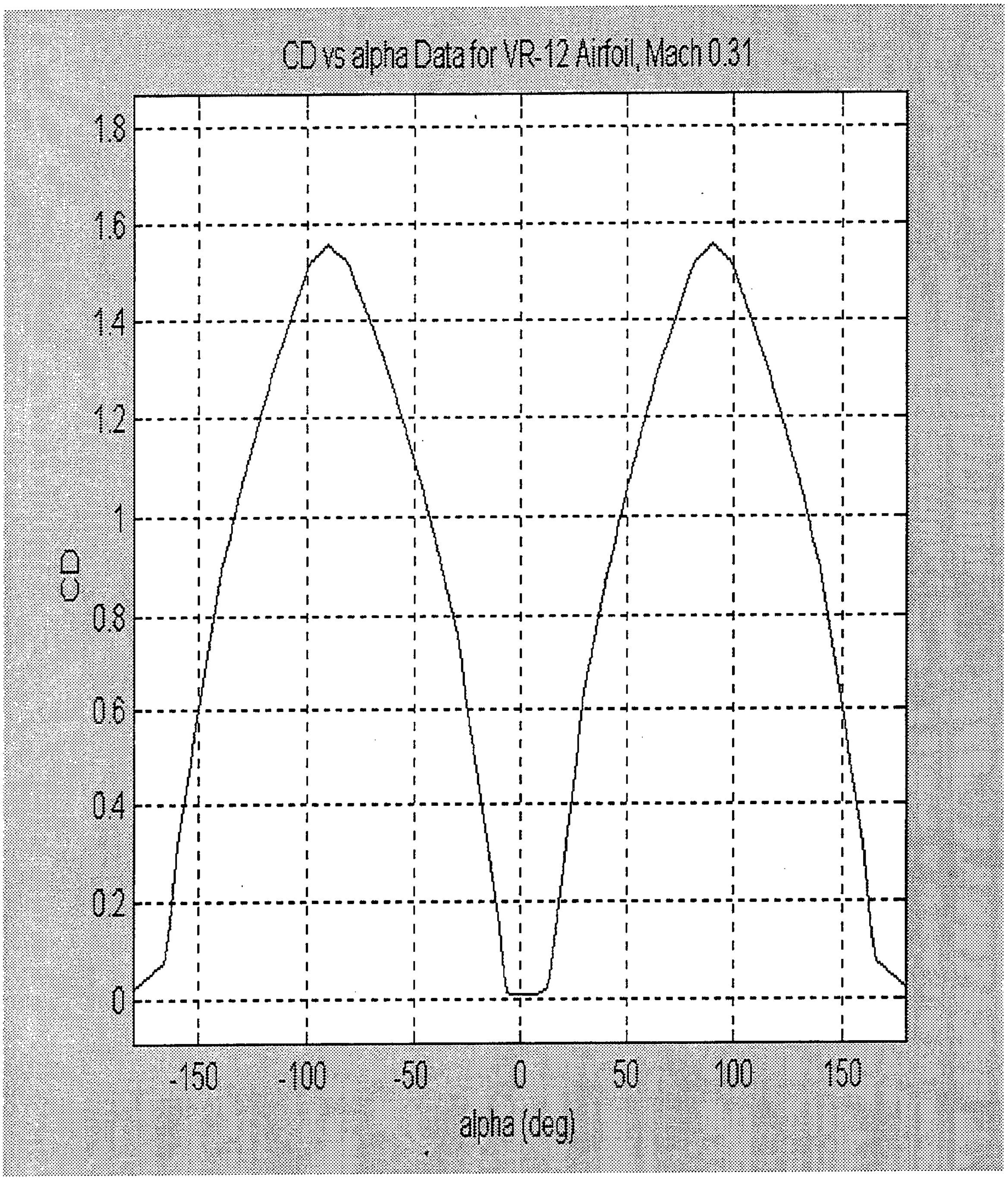


Figure C.4. VR-12 Cd Curve

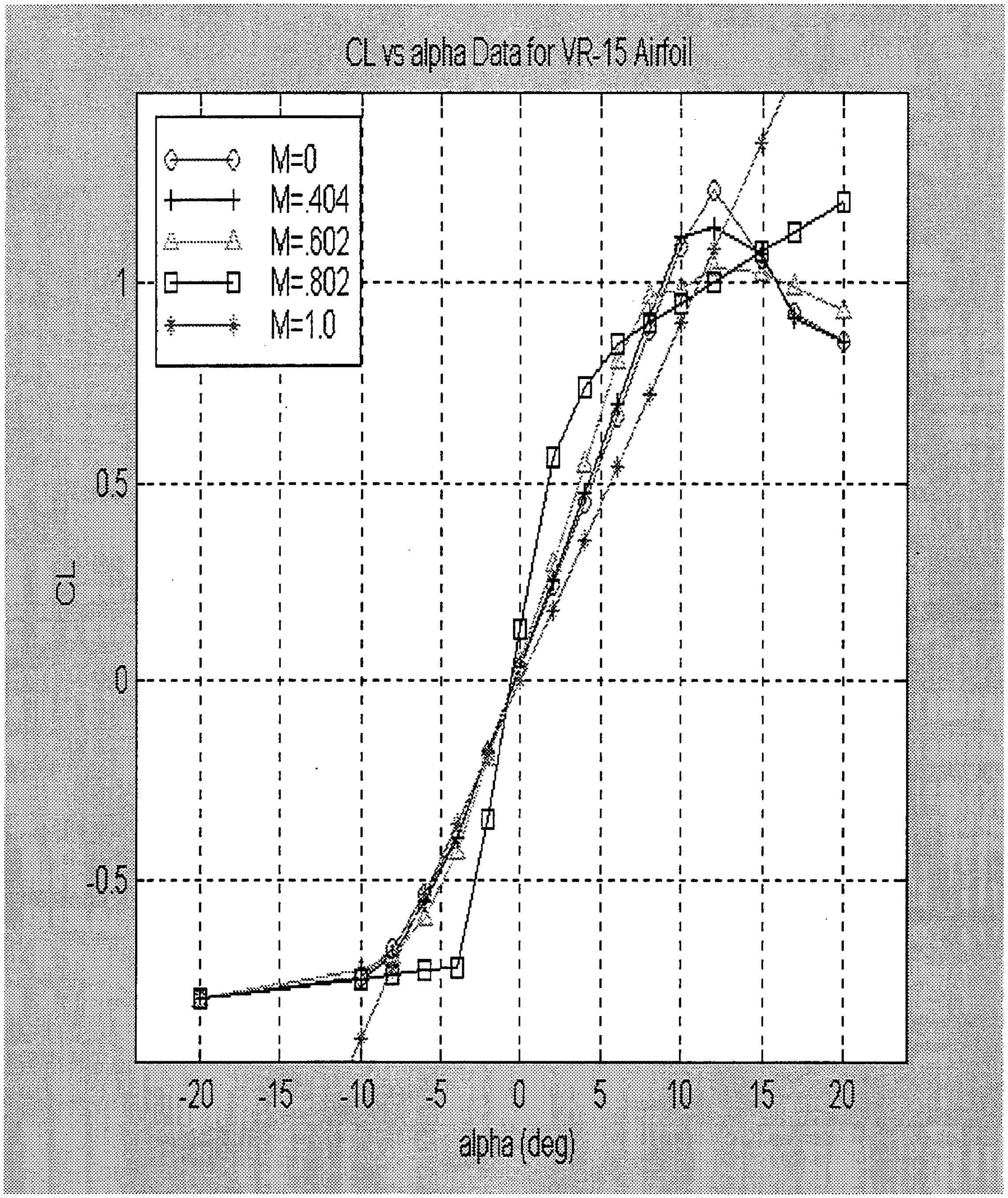


Figure C.5. VR-15 Cl Curve, Mach # Dependent

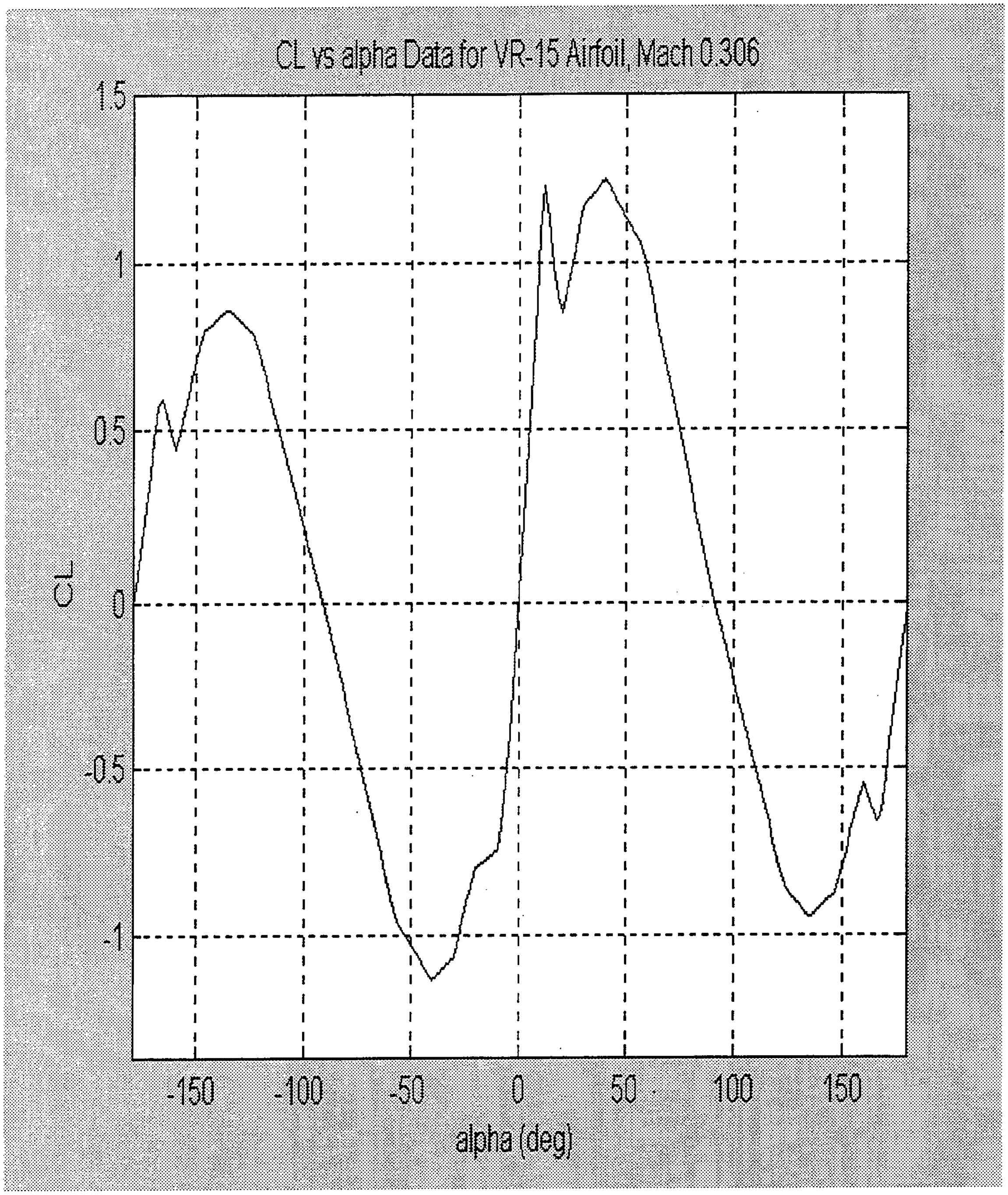


Figure C.6. VR-15 Cl Curve

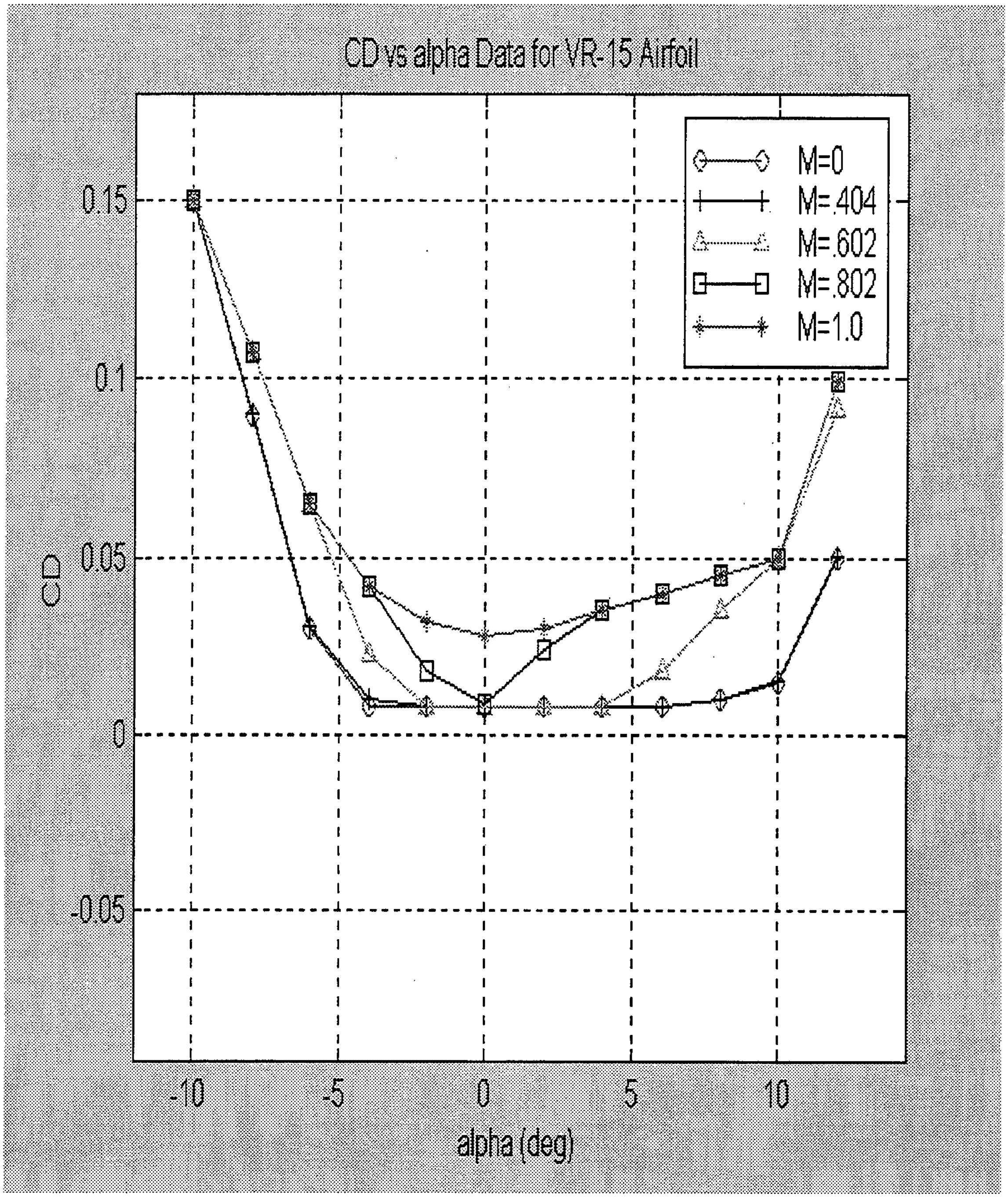


Figure C.7. VR-15 Cd Curve, Mach # Dependent

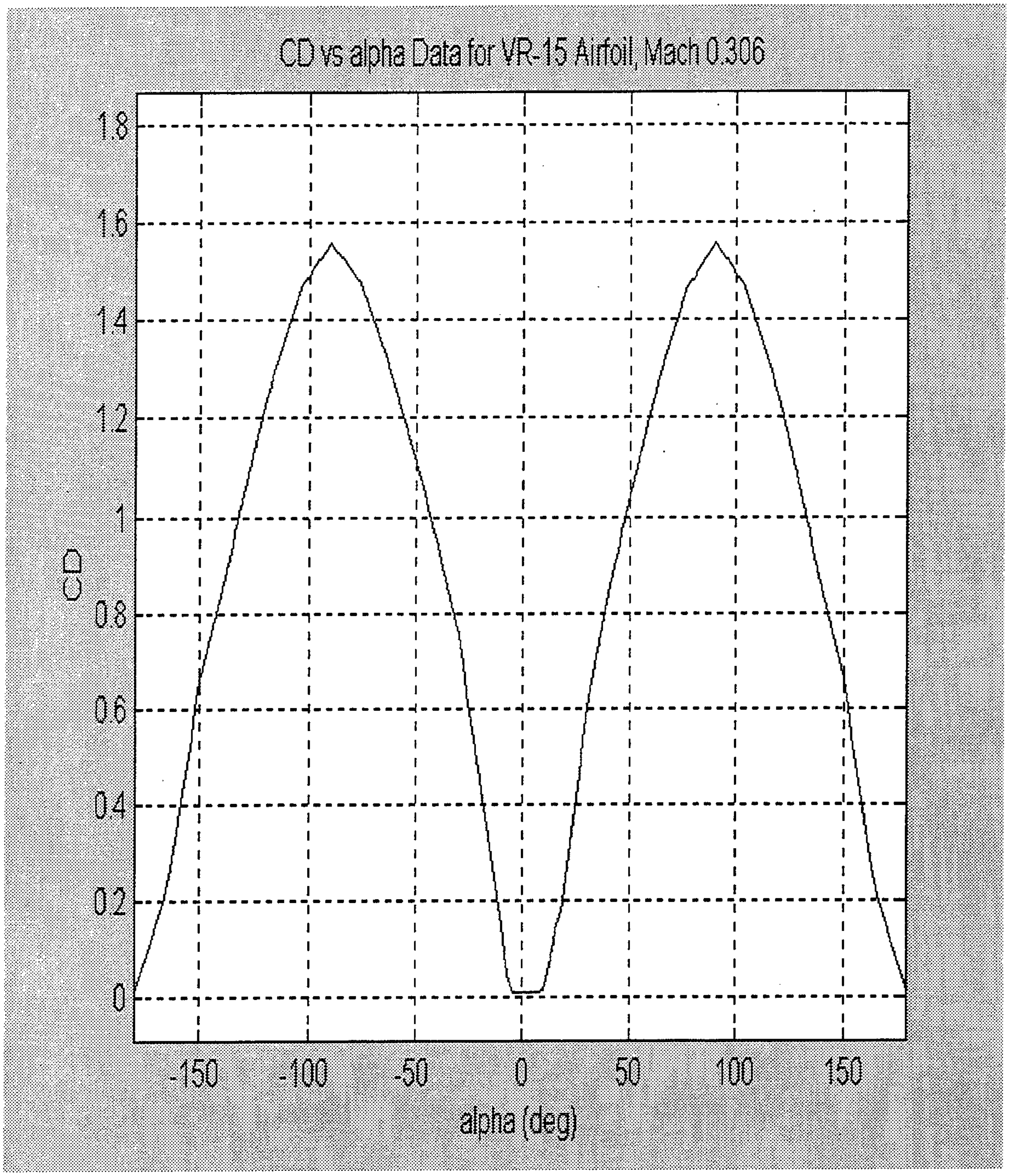


Figure C.8. VR-15 Cd Curve

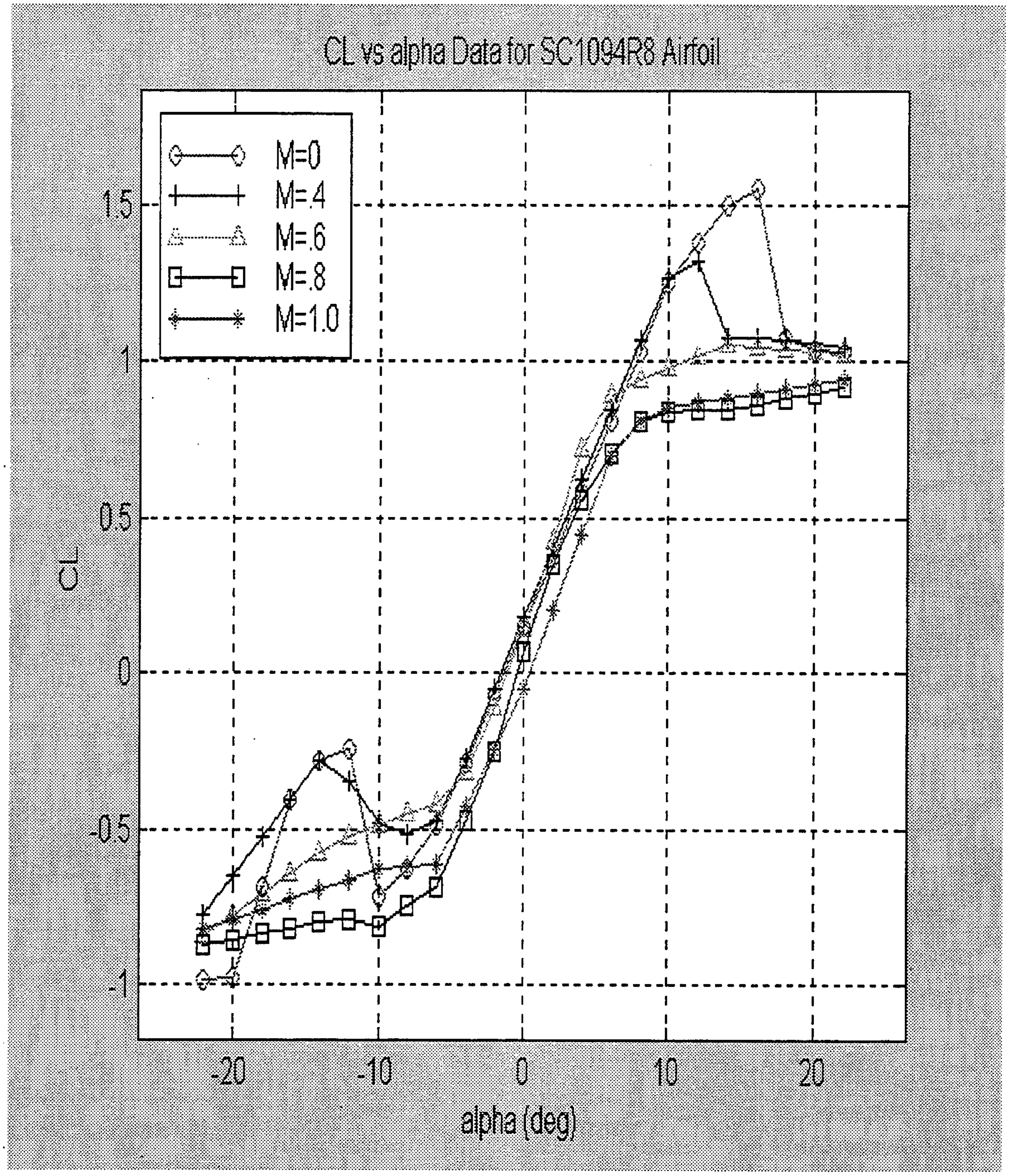


Figure C.9. Sc1094R8 Cl Curves, Mach # Dependent

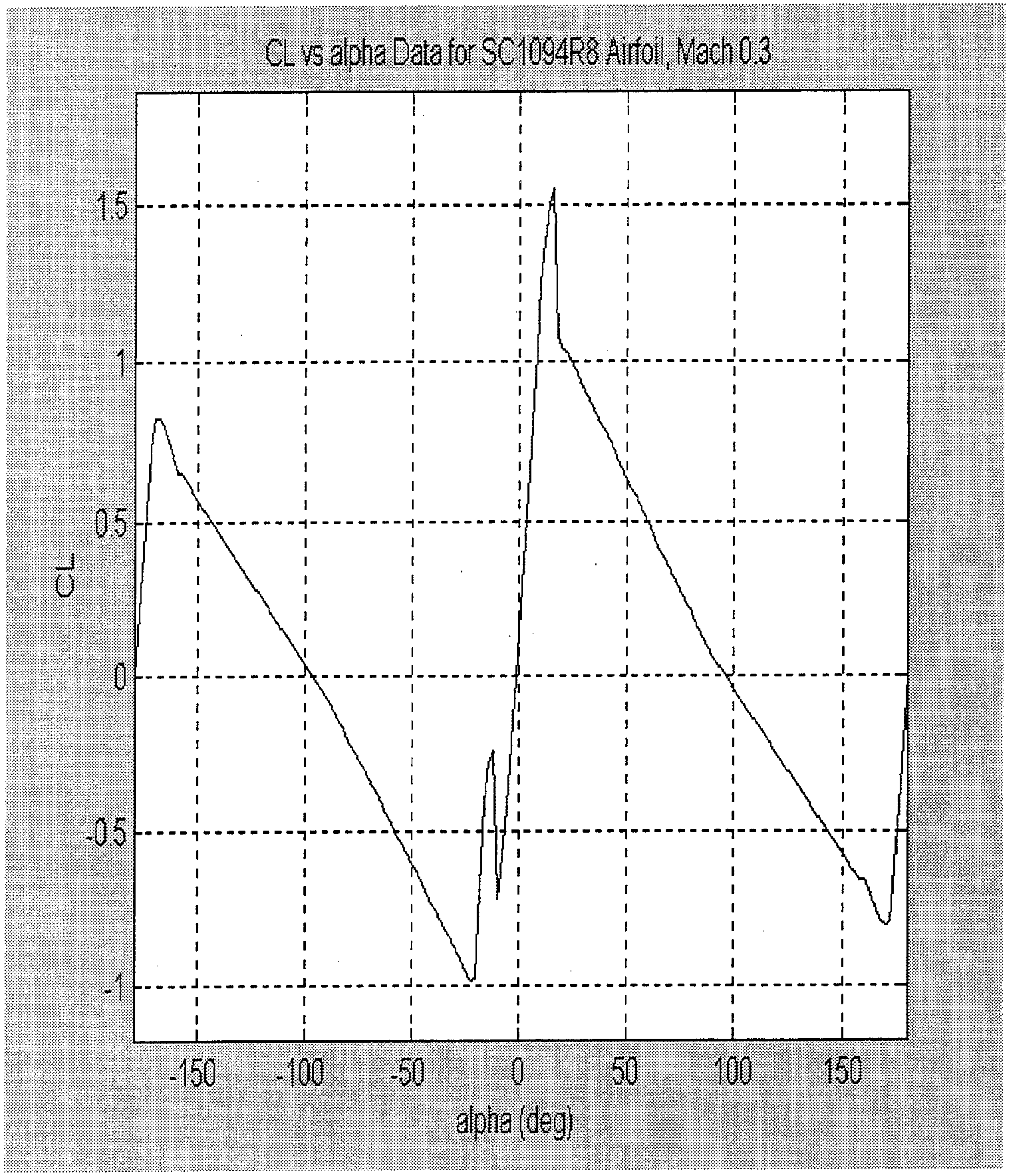


Figure C.10. Sc1094R8 Cl Curve

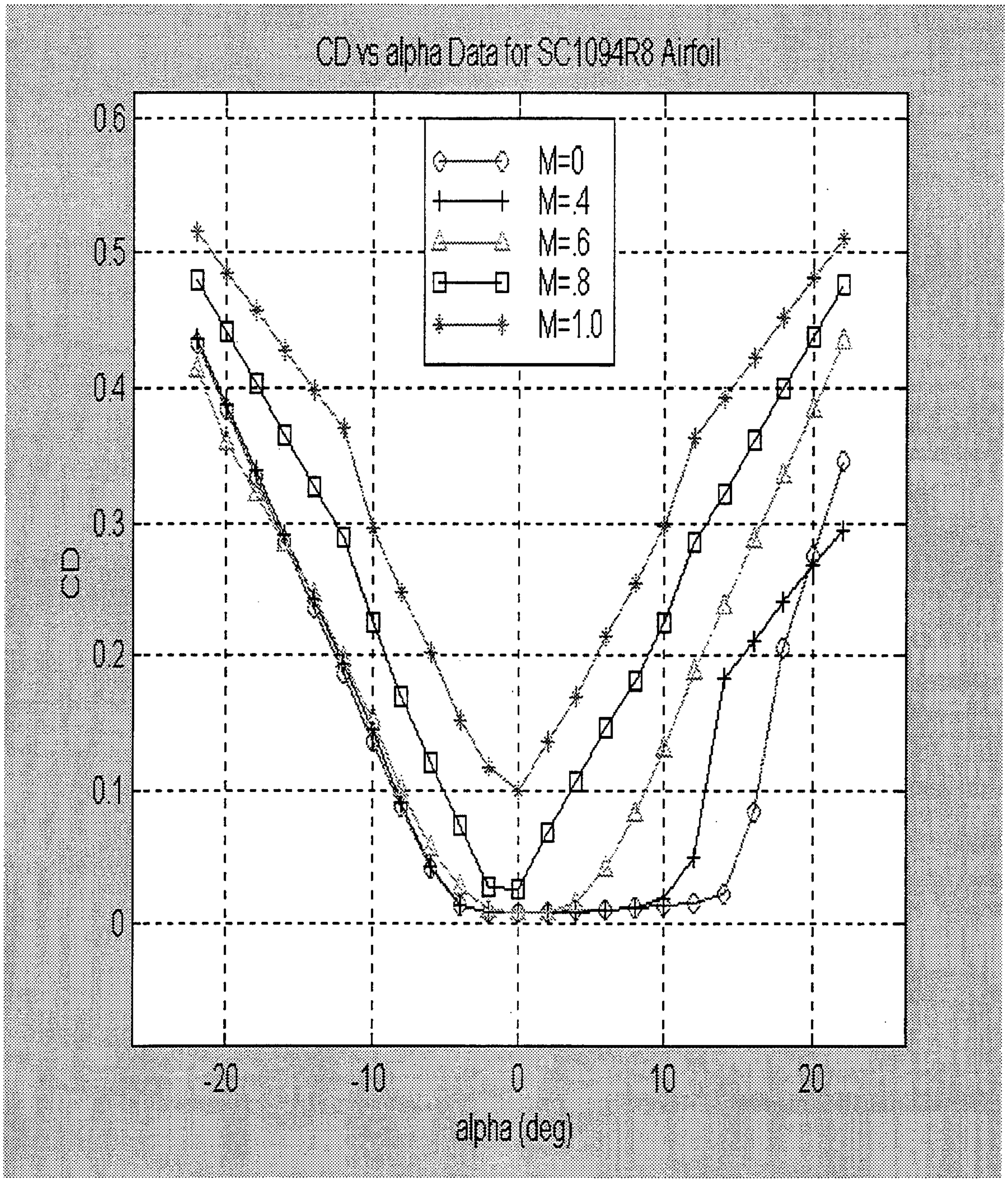


Figure C.11. Sc1094R8 Cd Curves, Mach # Dependent

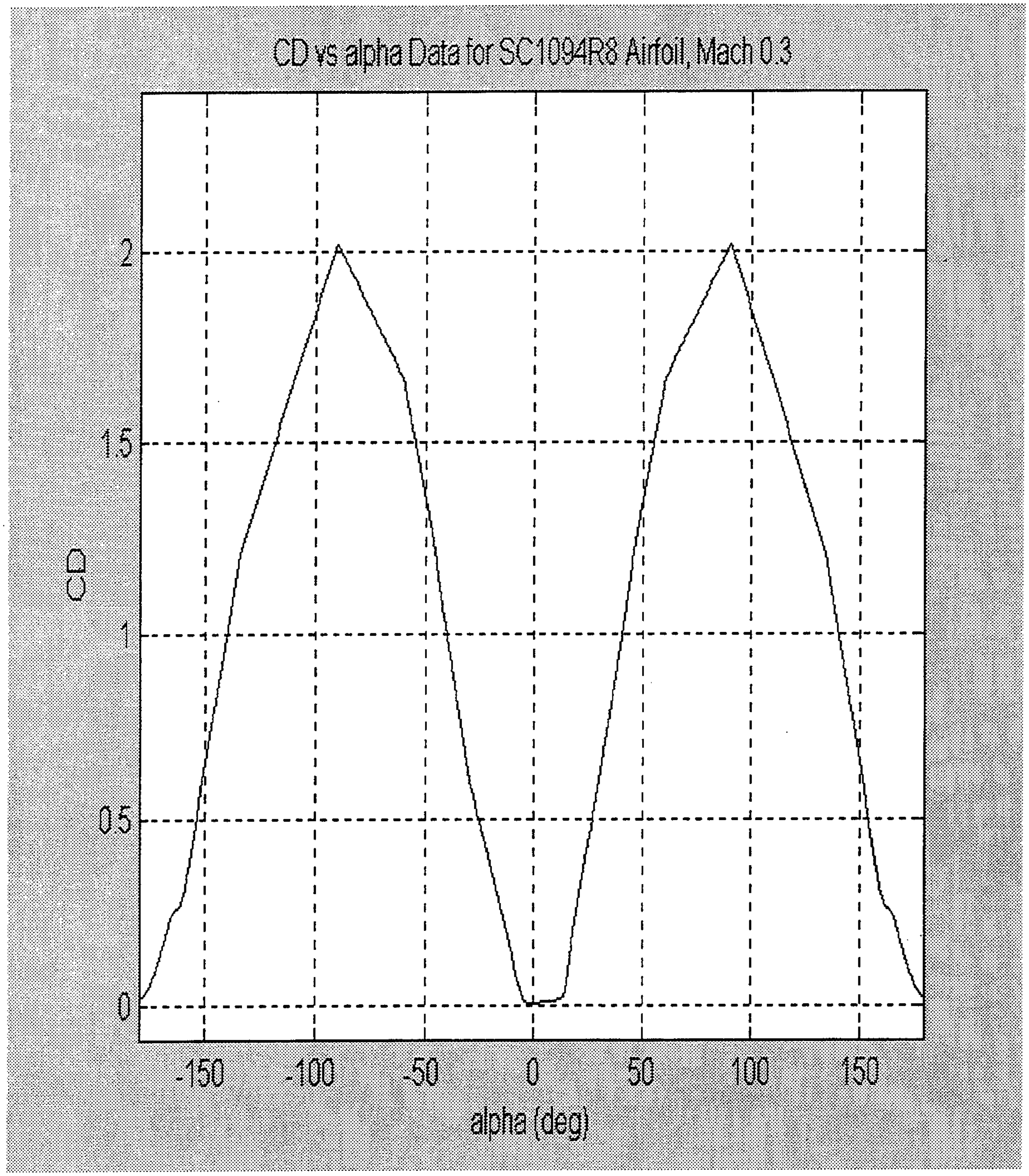


Figure C.12. Sc1094R8 Cd Curve

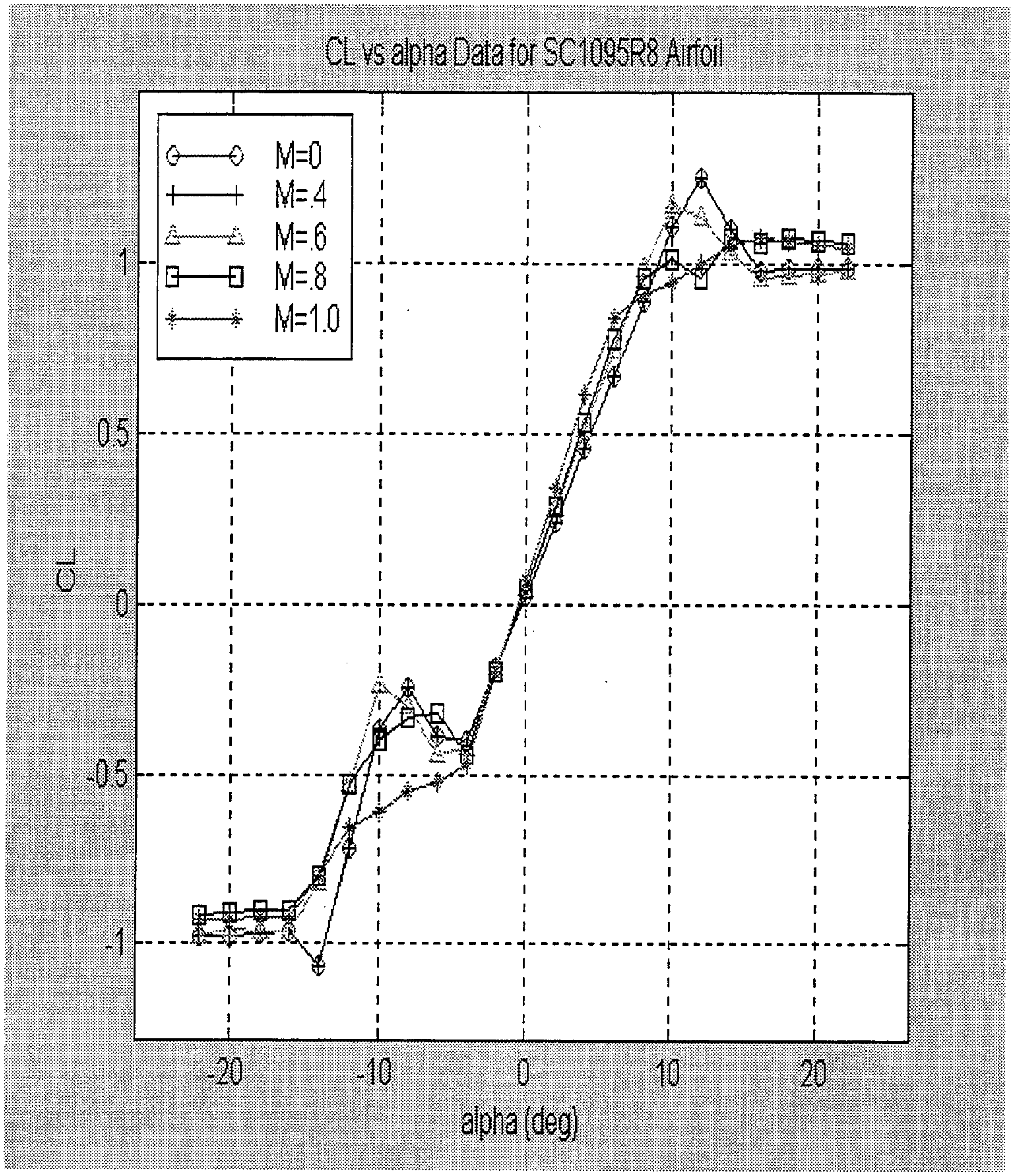


Figure C.13. Sc1095R8 Cl Curve, Mach # Dependent

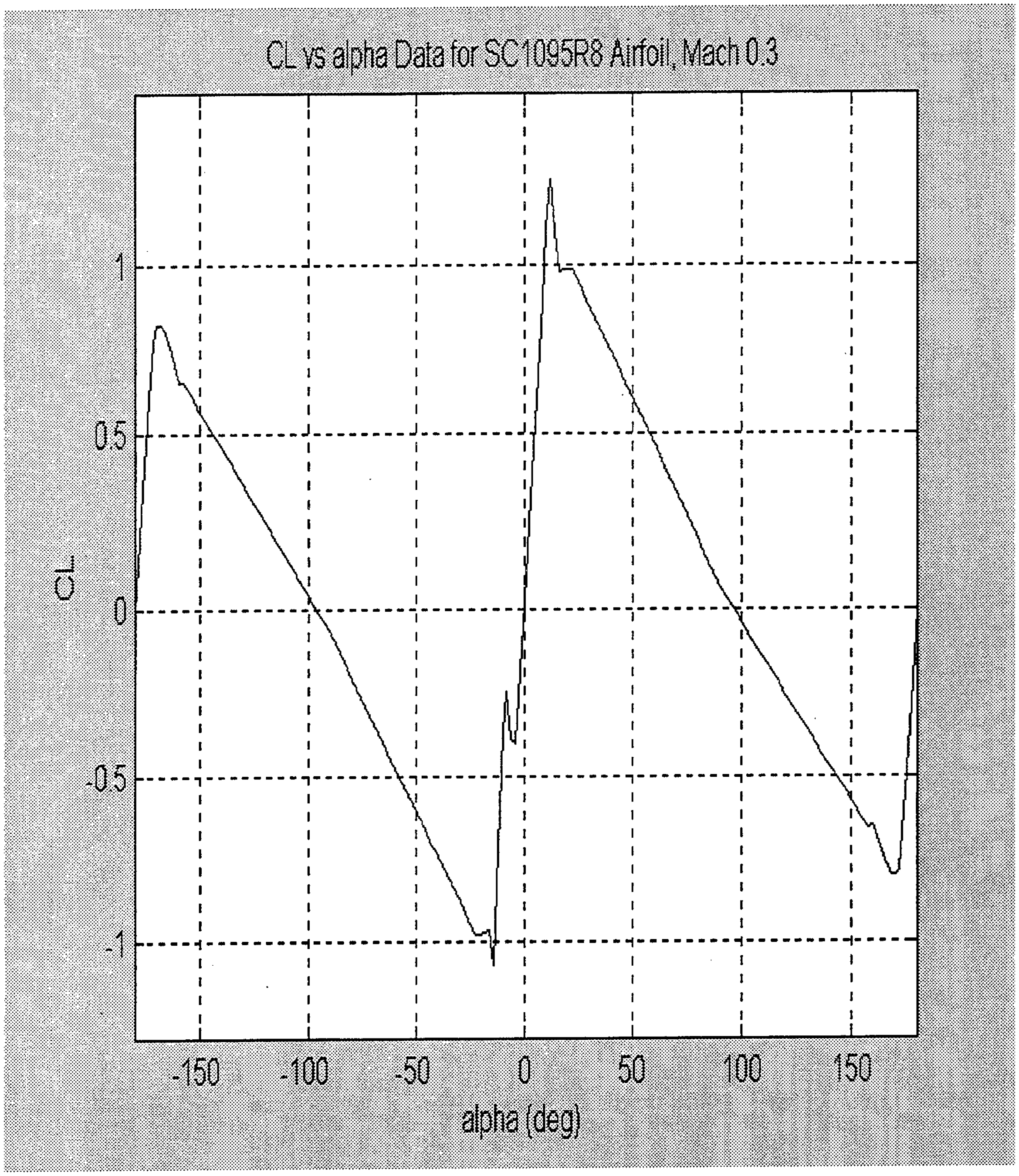


Figure C.14. Sc1095R8 Cl Curve

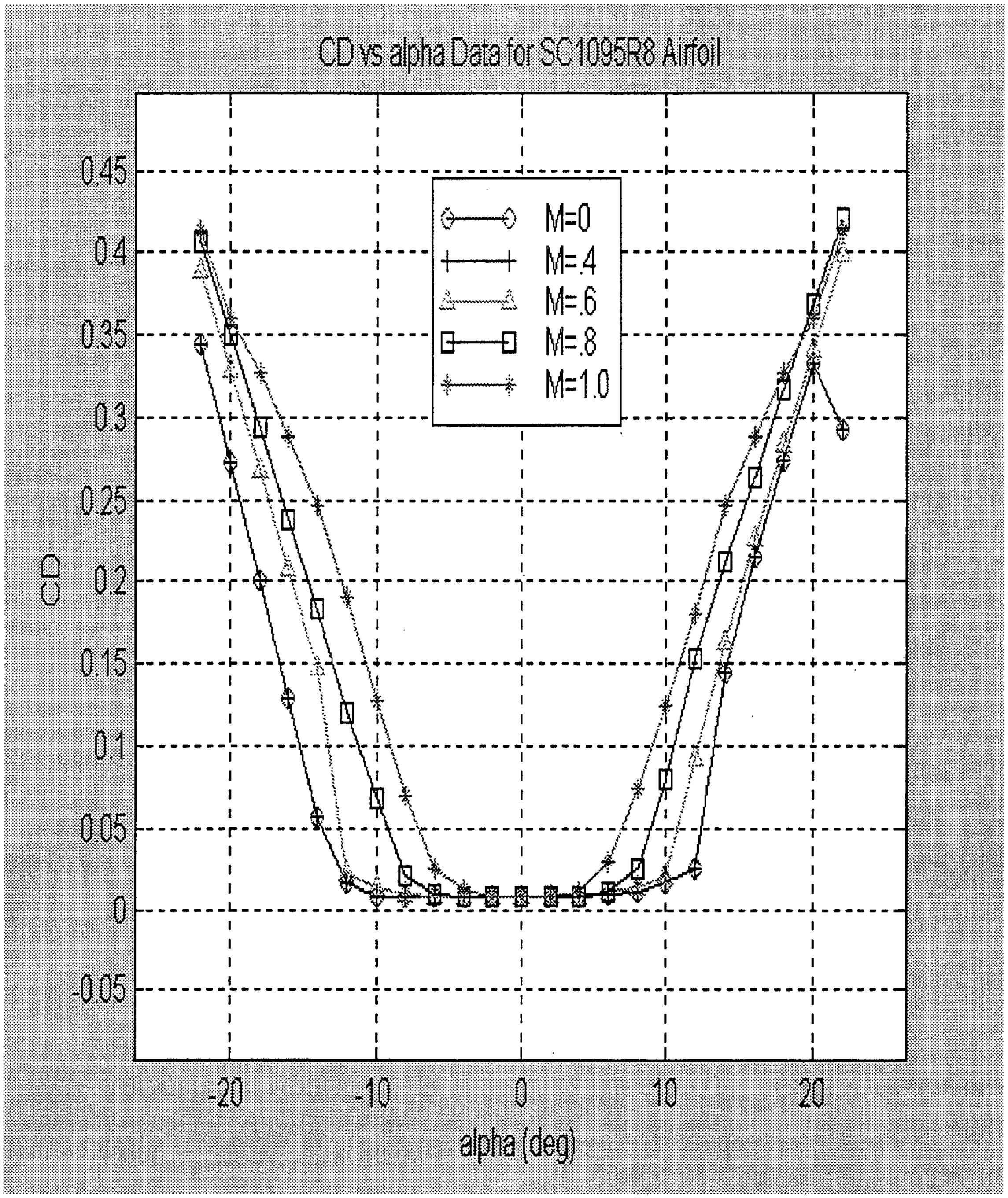


Figure C.15. Sc1095R8 Cd Curve, Mach # Dependent

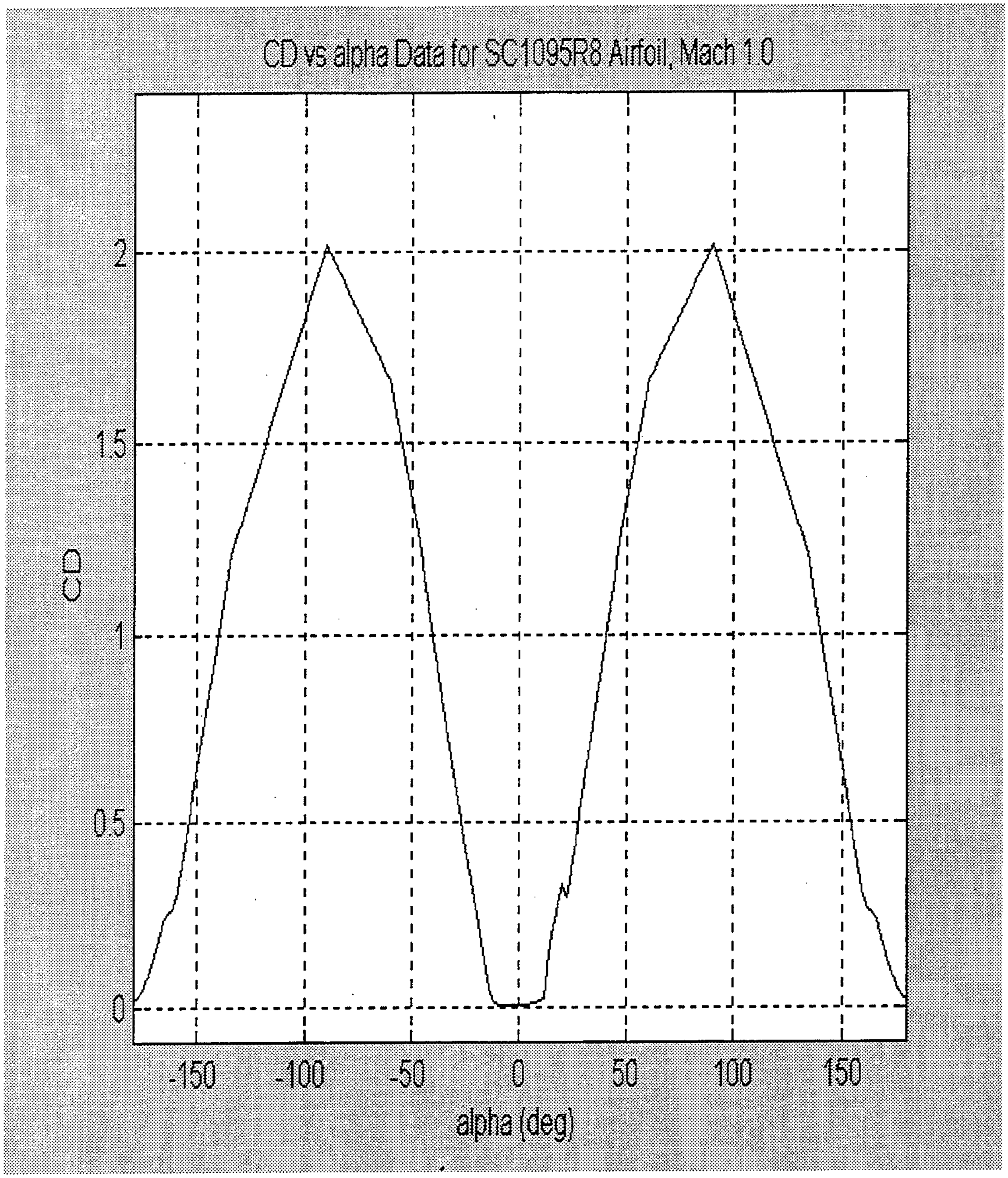


Figure C.16. Sc1095R8 Cd Curve

APPENDIX D. AIRLOAD PLOTS

The following four Airload Plots are with "fish hook" twist model included.

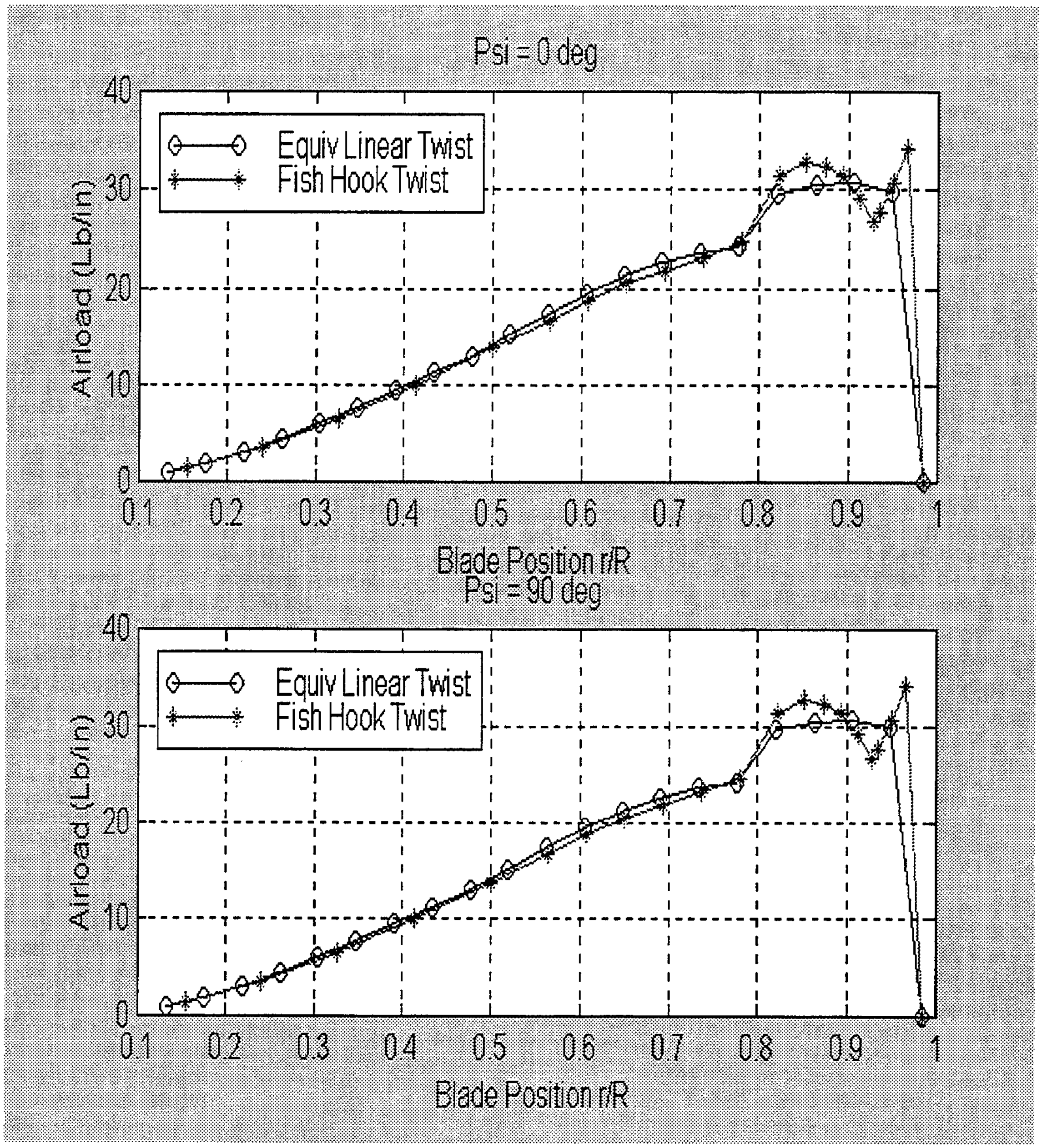


Figure D.1. Linear Twist vs. Actual UH-60A Twist, HOGE, Ψ= 0, 90°

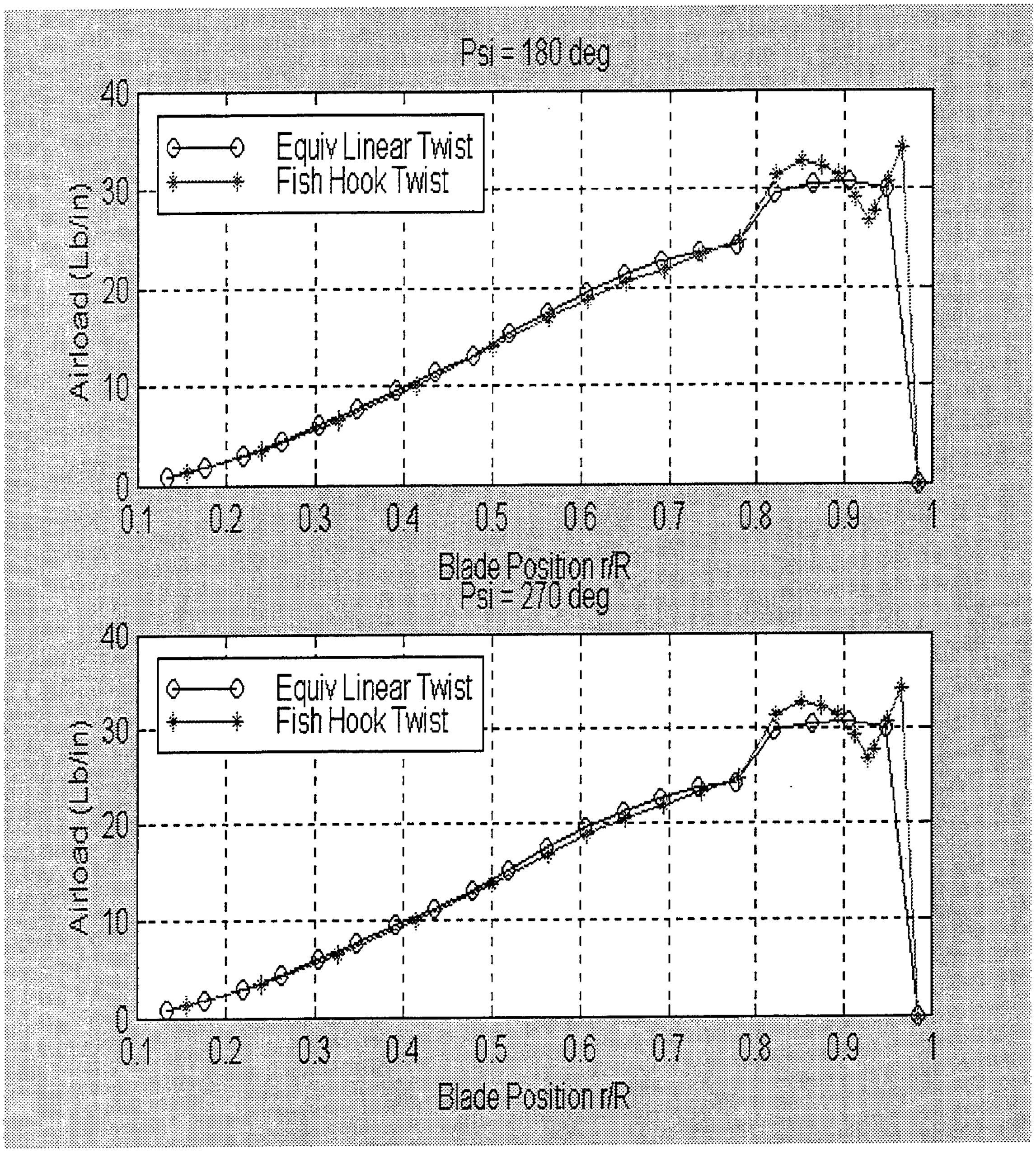


Figure D.2. Linear Twist vs. Actual UH-60A Twist, HOGE, Ψ= 180, 270°

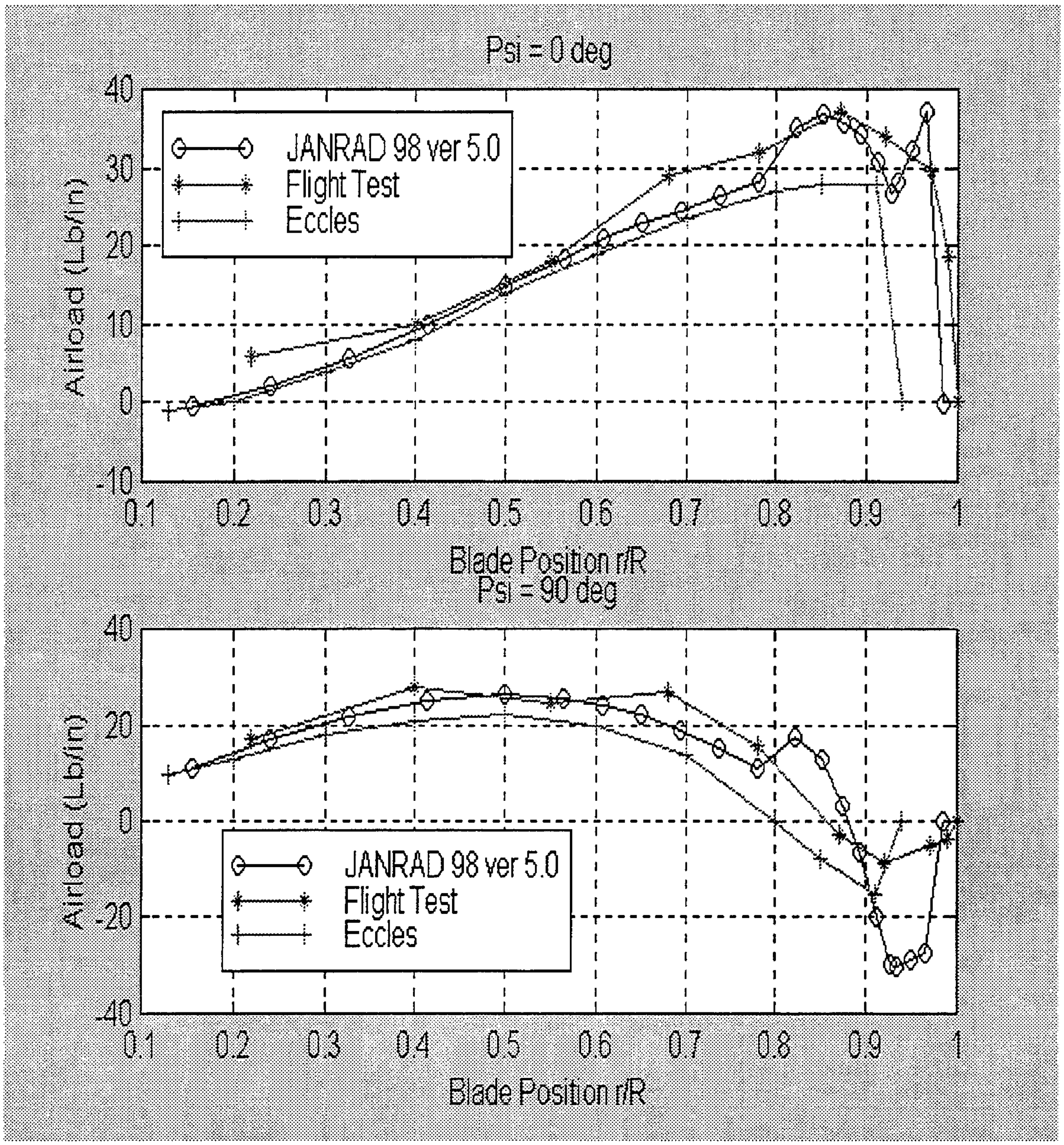


Figure D.3. UH-60A Radial Airload Distribution, 115 Knots, $\Psi = 0, 90^{o}$

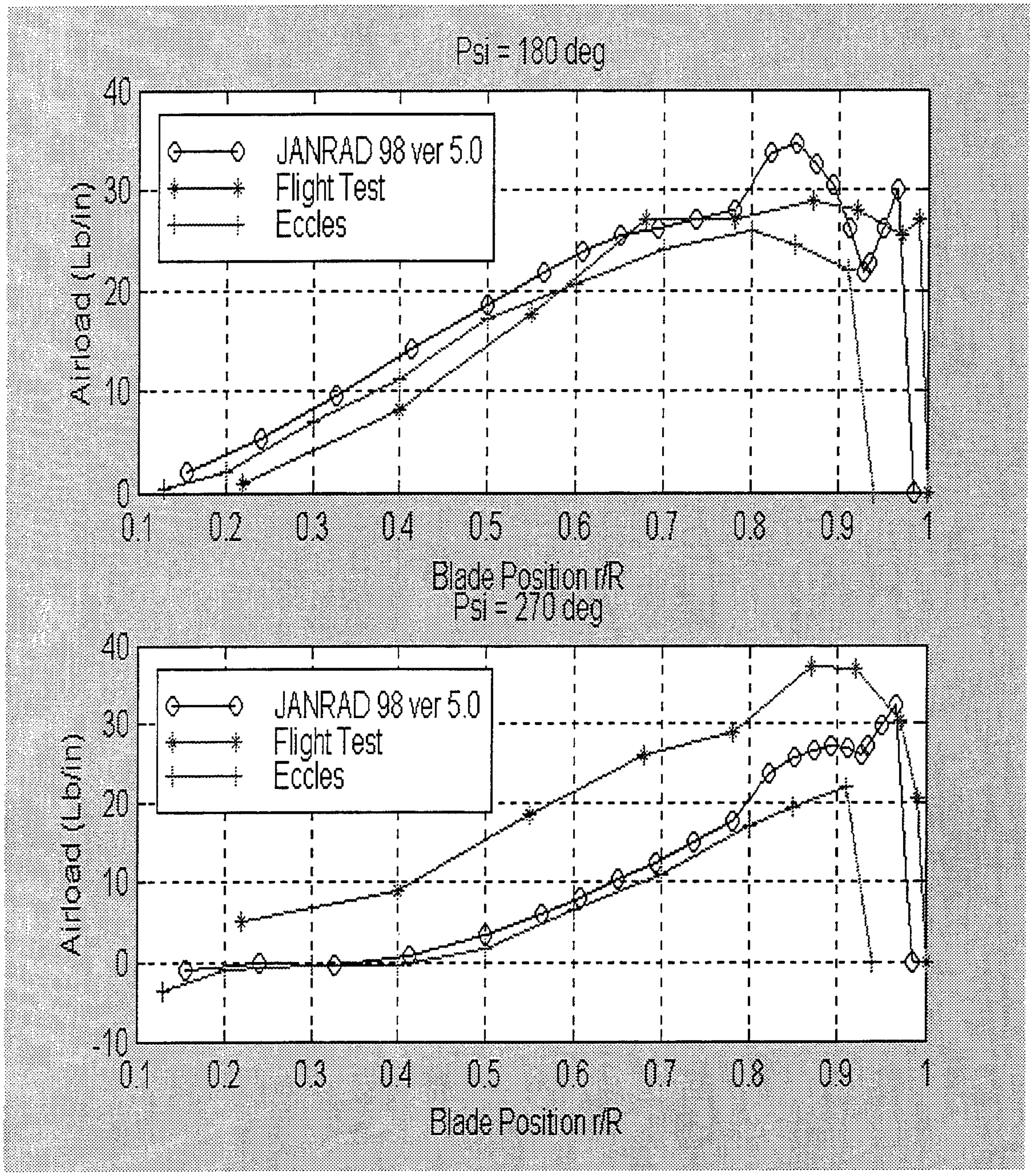


Figure D.4. UH-60A Radial Airload Distribution, 115 Knots, Ψ= 180, 270°

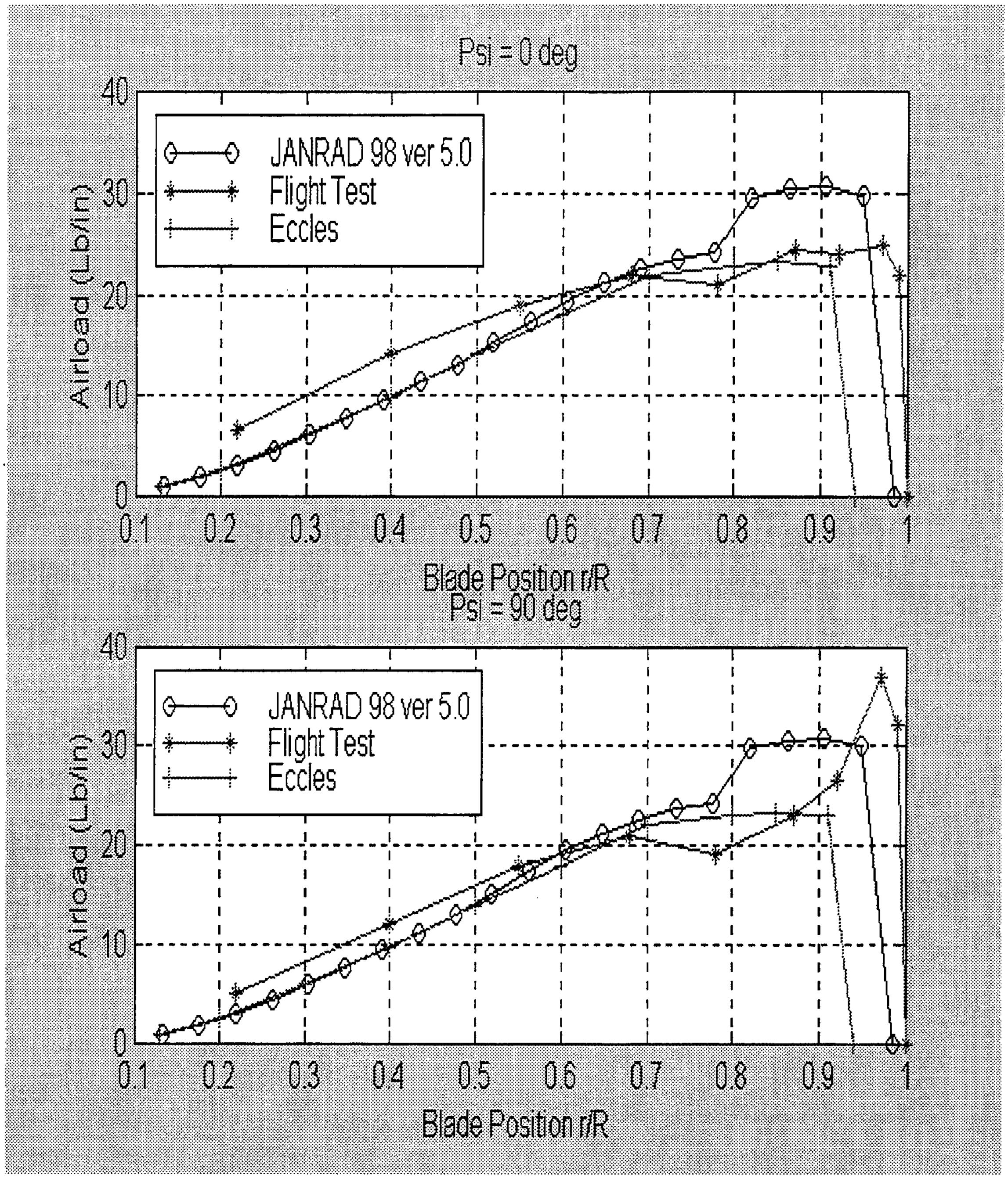


Figure D.5. UH-60A Radial Airload Distribution, HOGE, Ψ= 0, 90°

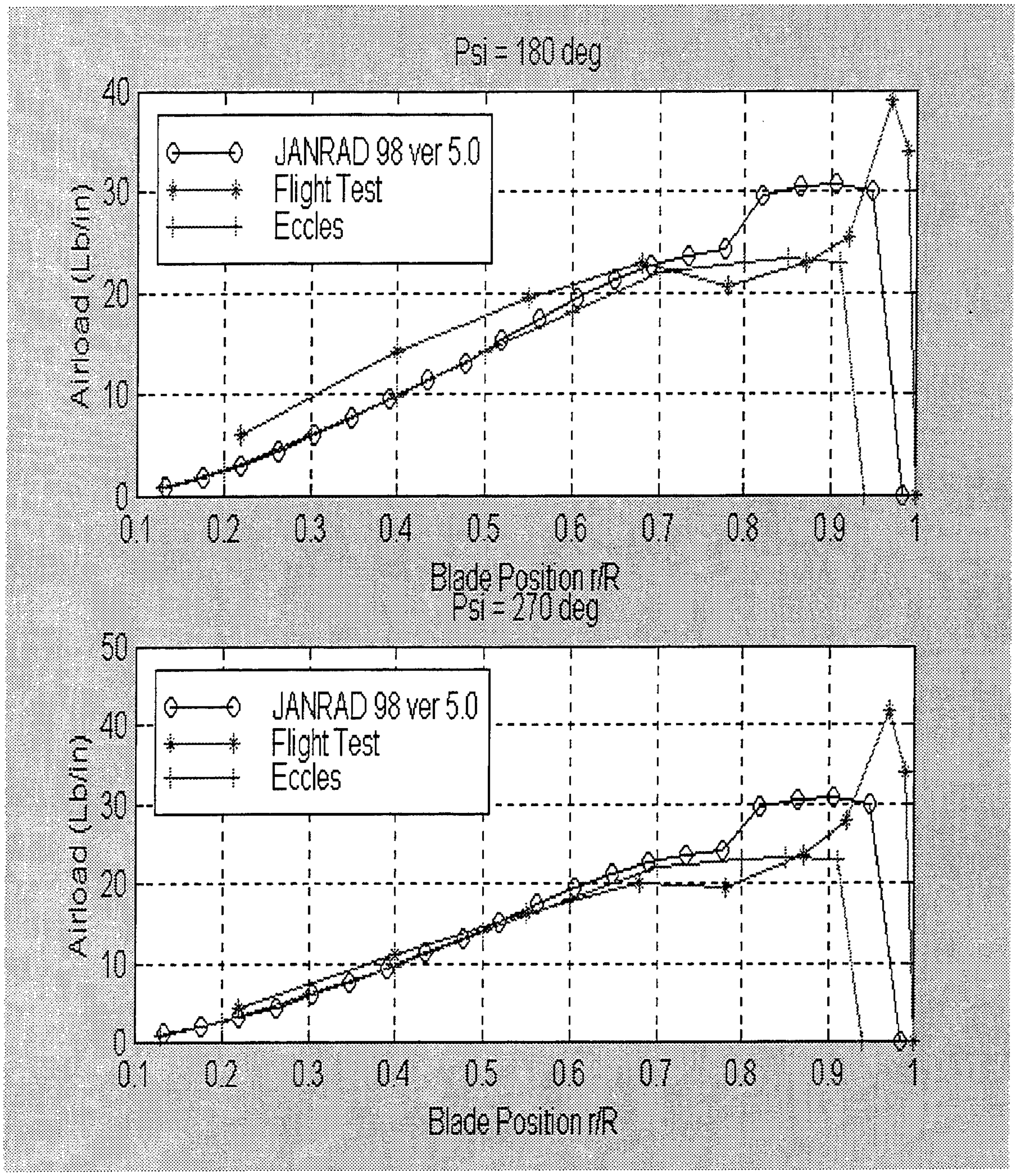


Figure D.6. UH-60A Radial Airload Distribution, HOGE, Ψ= 180, 270°

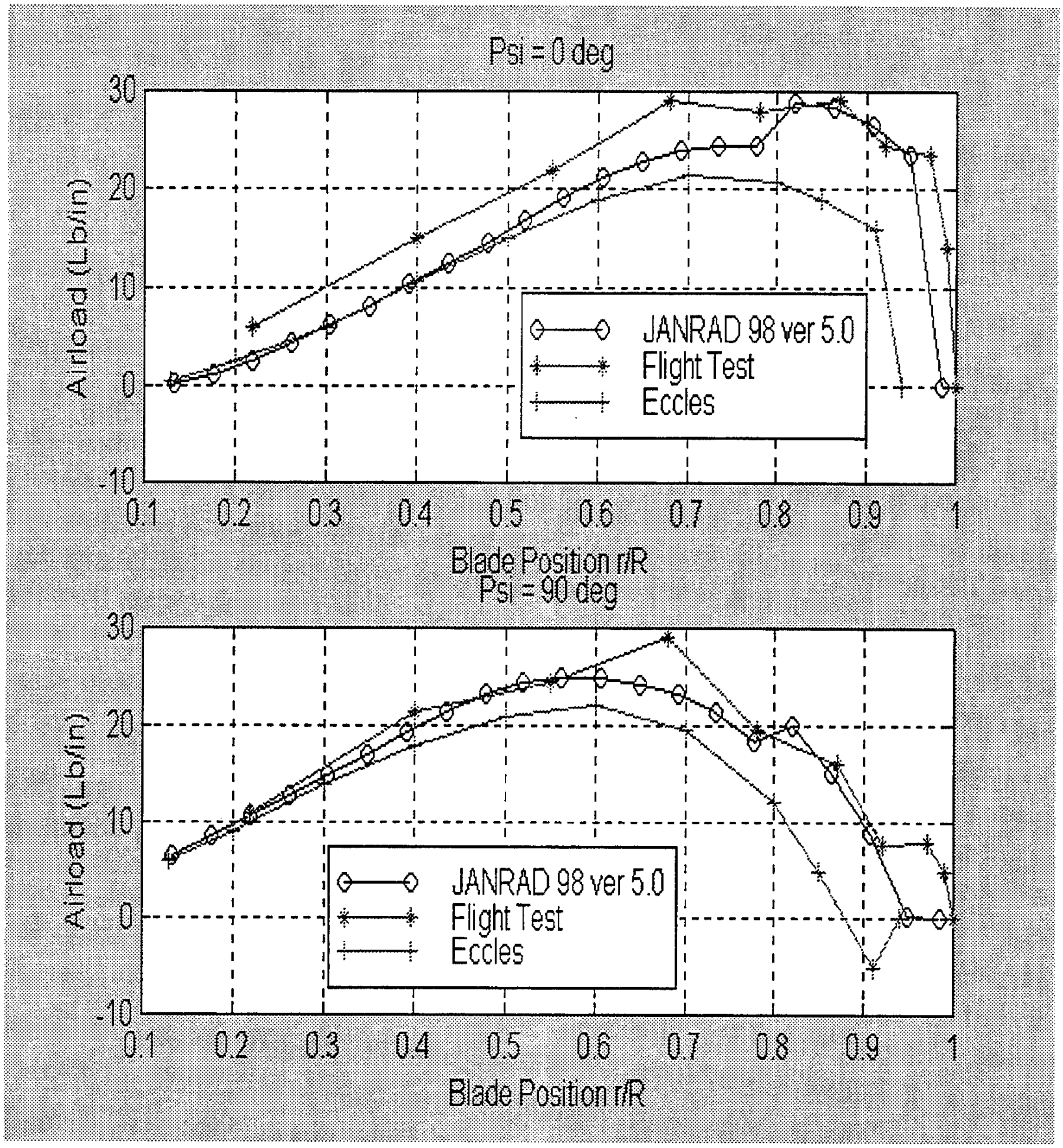


Figure D.7. UH-60A Radial Airload Distribution, 65 Knots, Ψ= 0, 90°

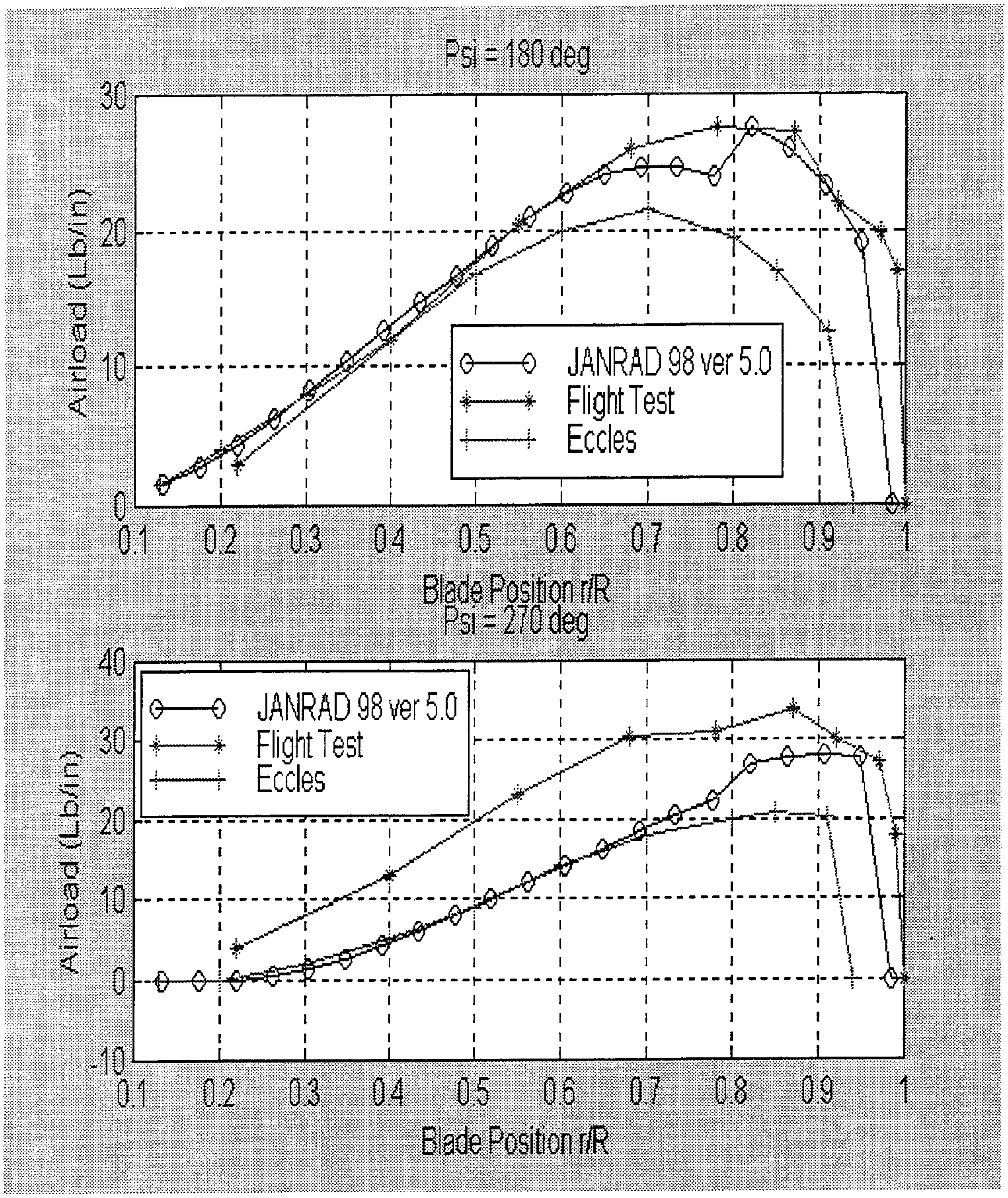


Figure D.8. UH-60A Radial Airload Distribution, 65 Knots, Ψ= 180, 270°

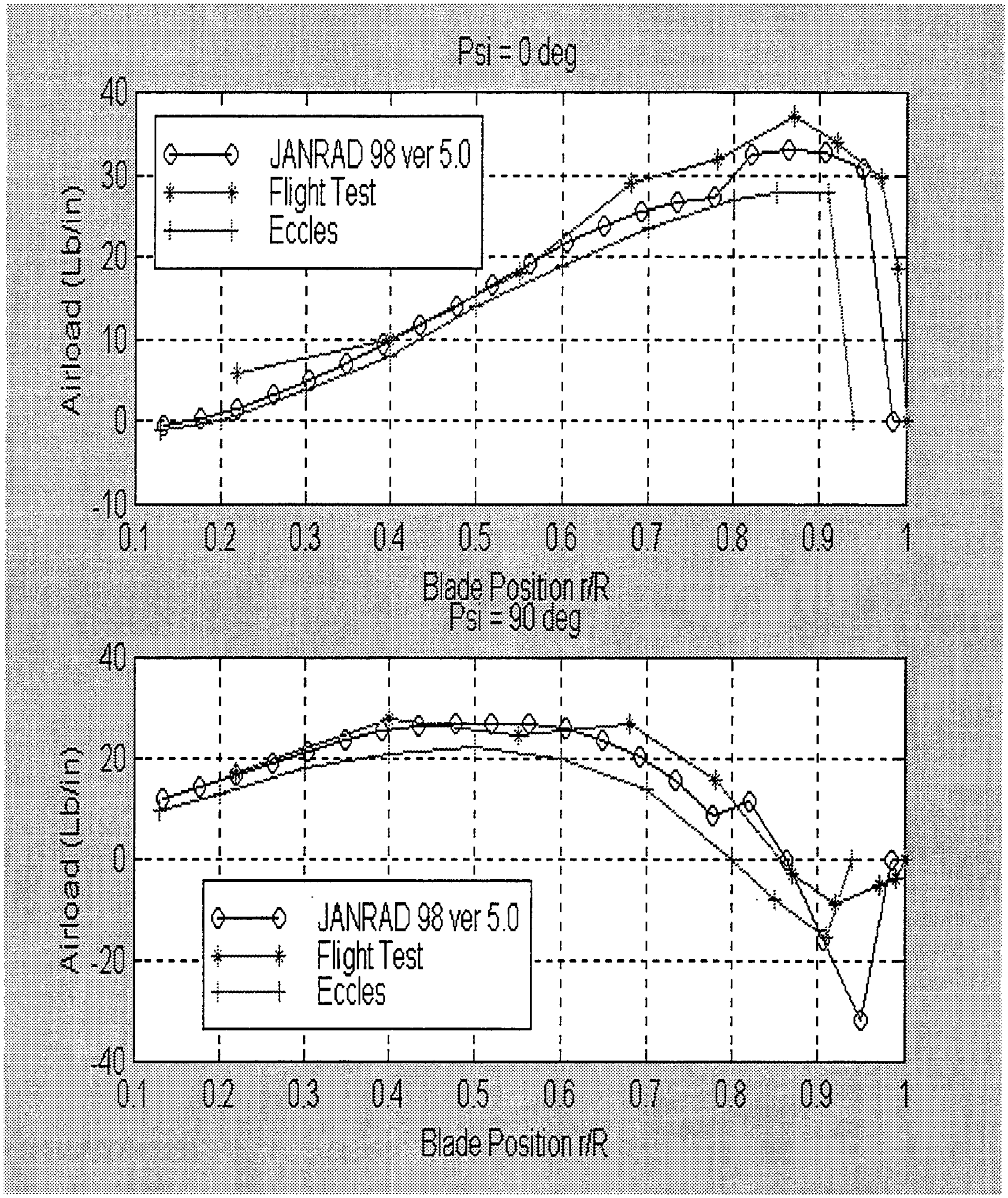


Figure D.9. UH-60A Radial Airload Distribution, 115 Knots, Ψ= 0, 90°

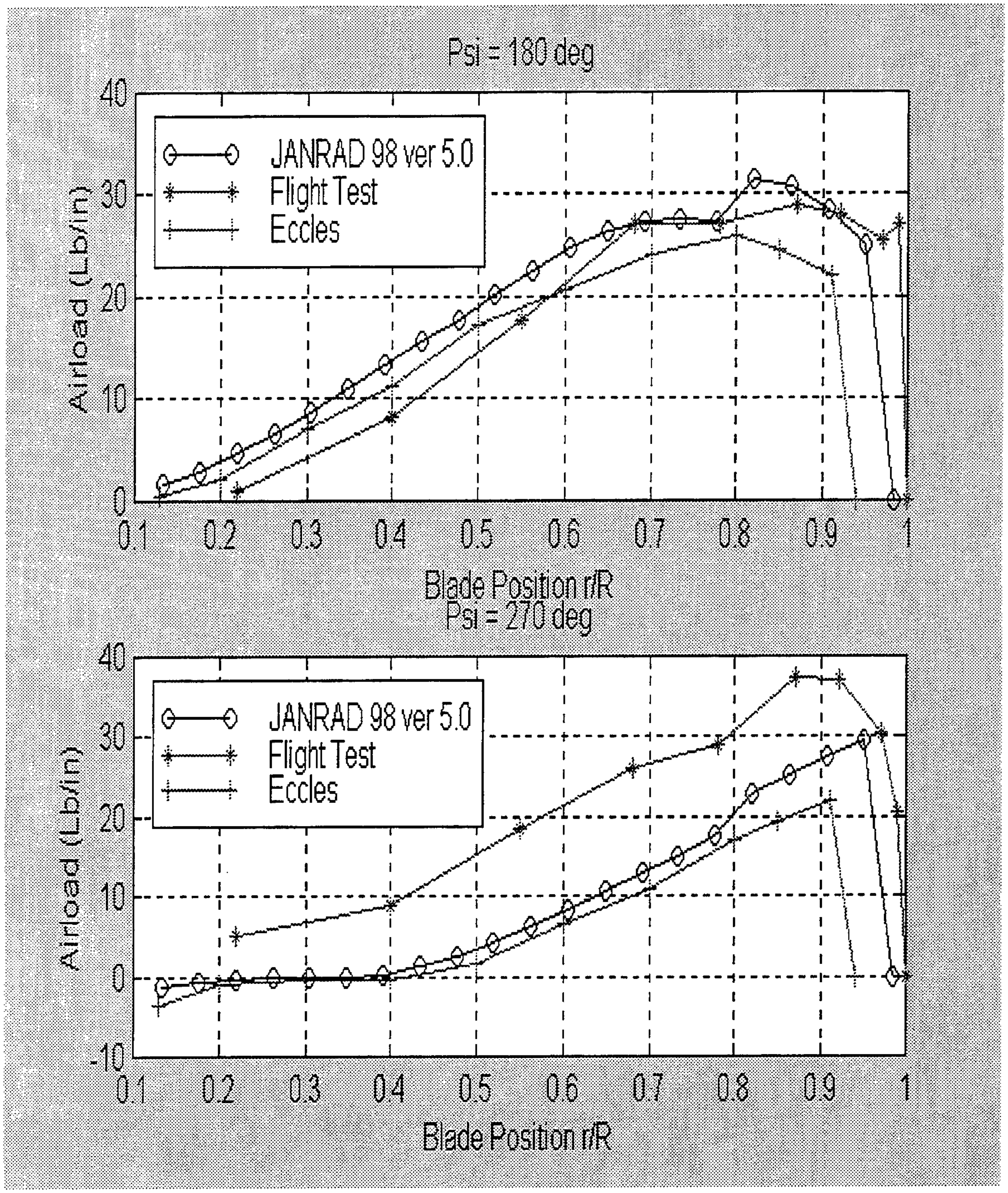


Figure D.10. UH-60A Radial Airload Distribution, 115 Knots, Ψ= 180, 270°

APPENDIX E. POWER REQUIRED CURVES

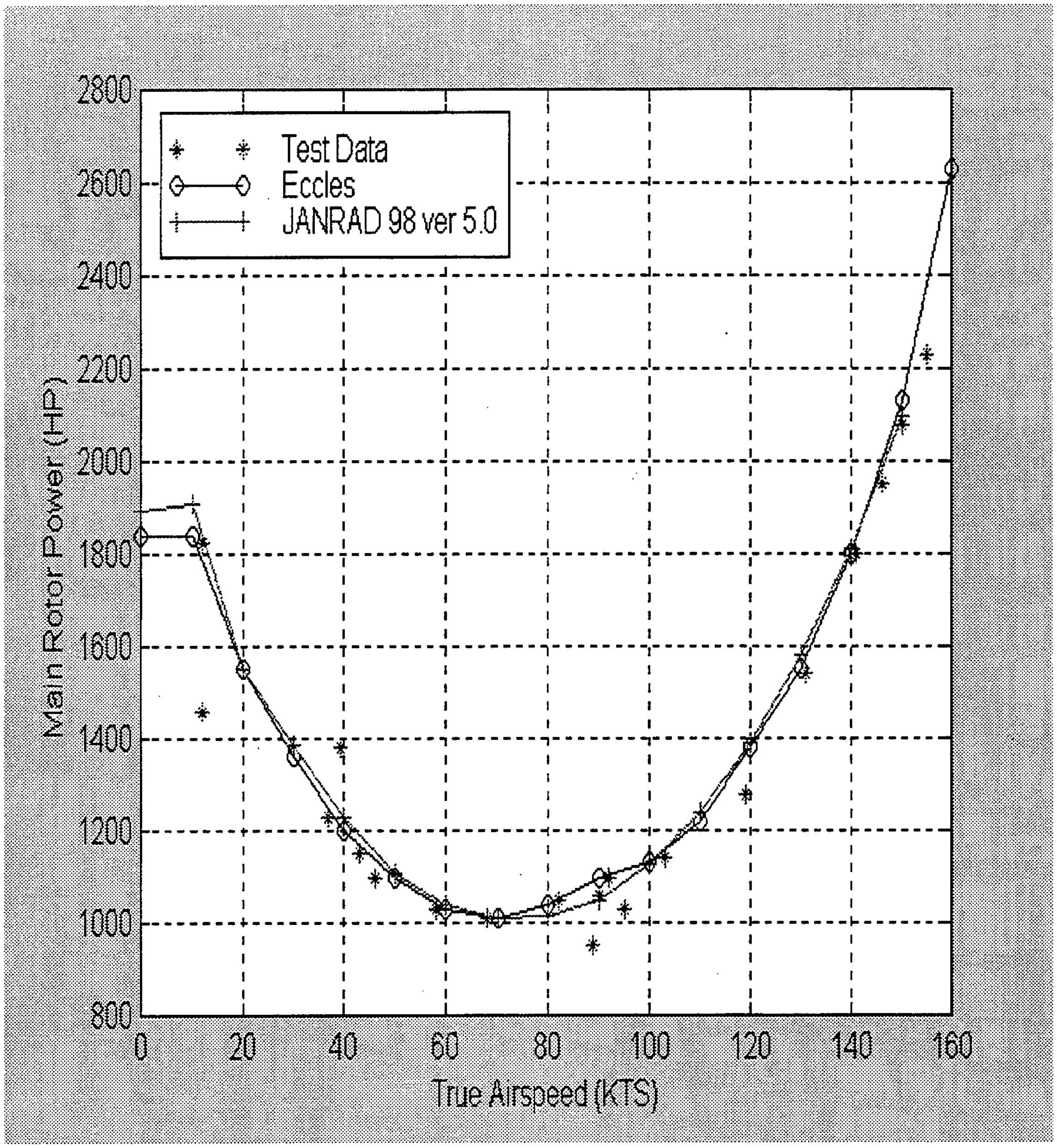


Figure E.1. UH-60A Power Required vs Airspeed, Flight #84

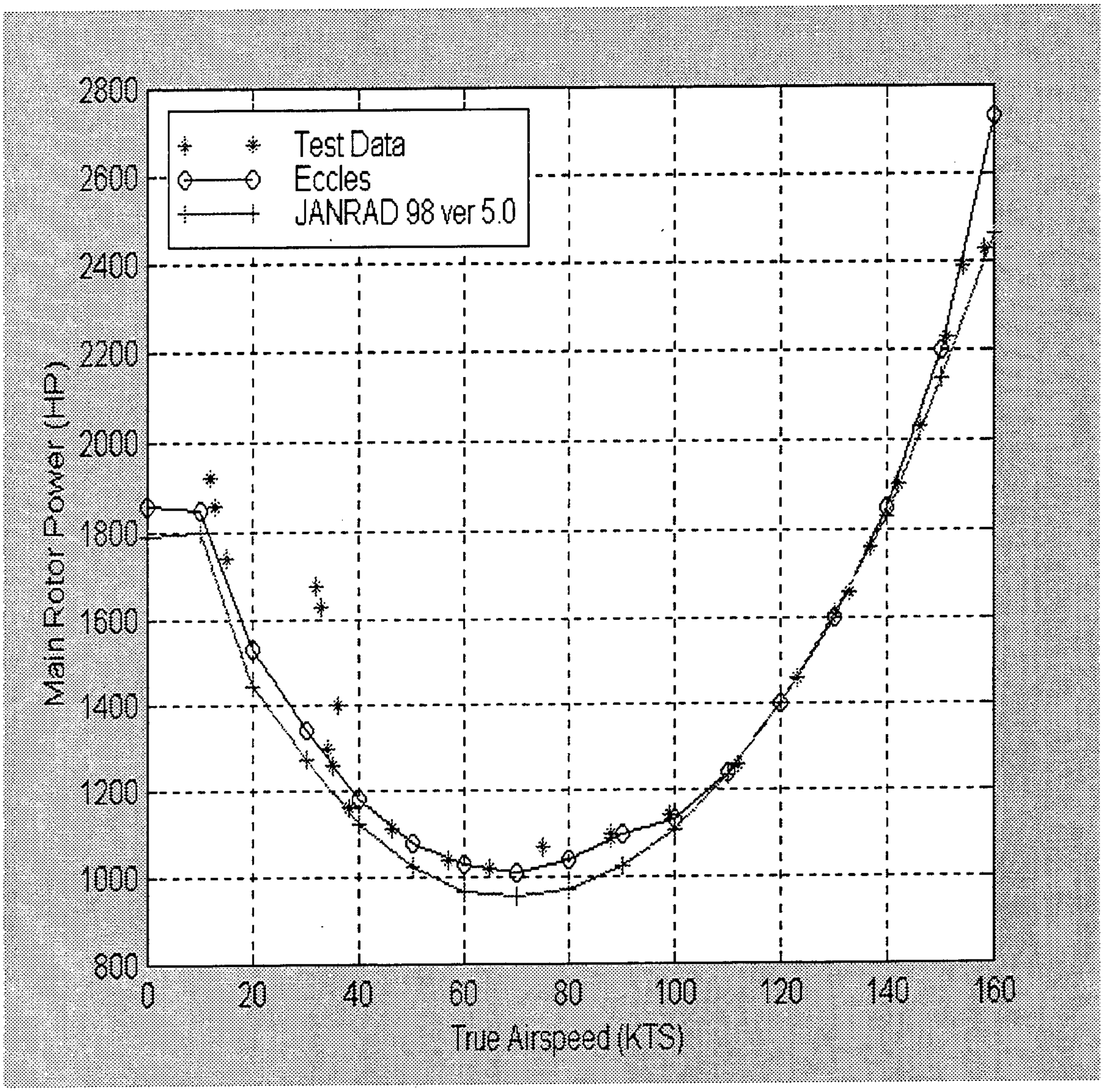


Figure E.2. UH-60A Power Required vs Airspeed, Flight #85

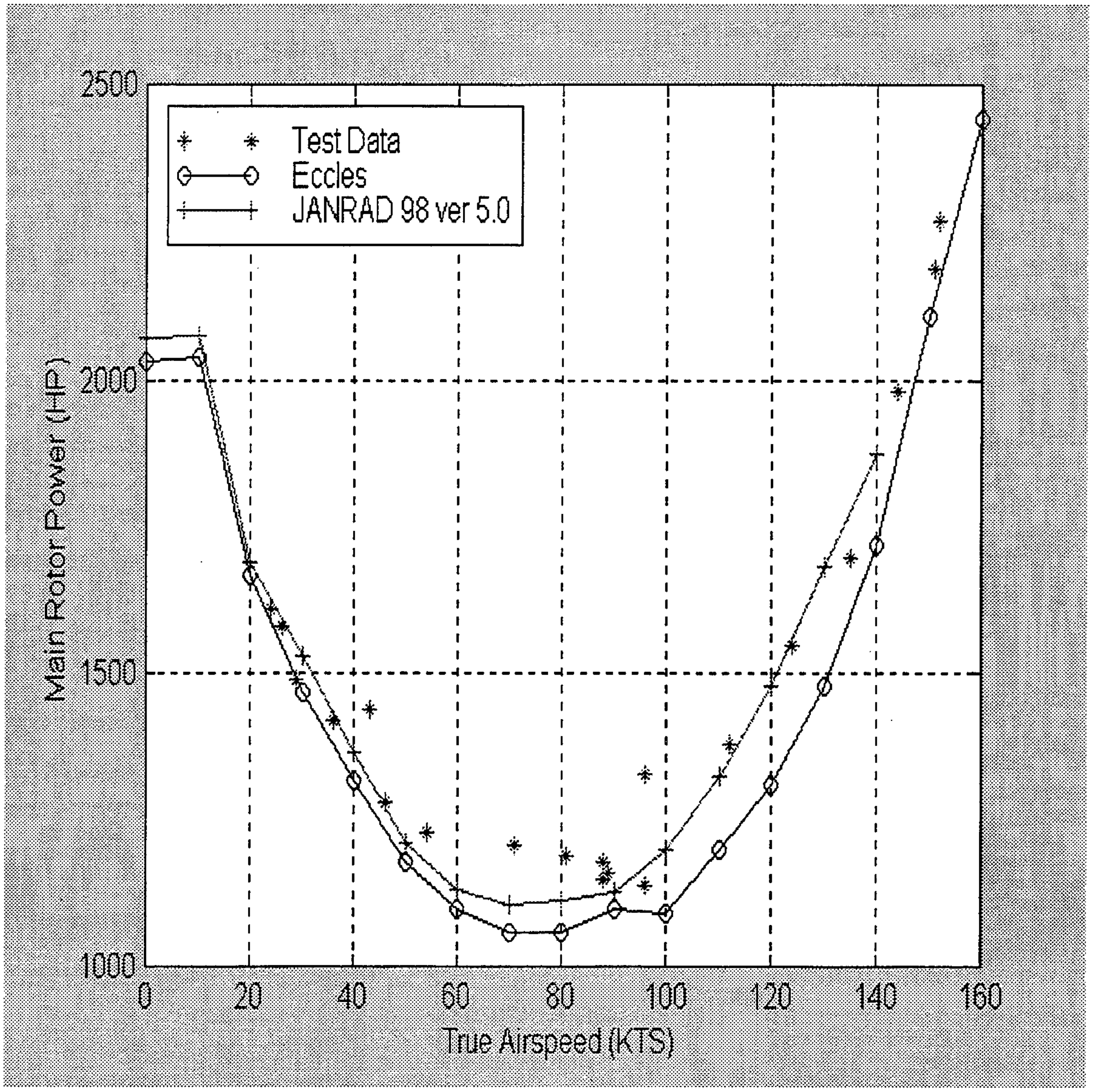


Figure E.3. UH-60A Power Required vs Airspeed, Flight #88

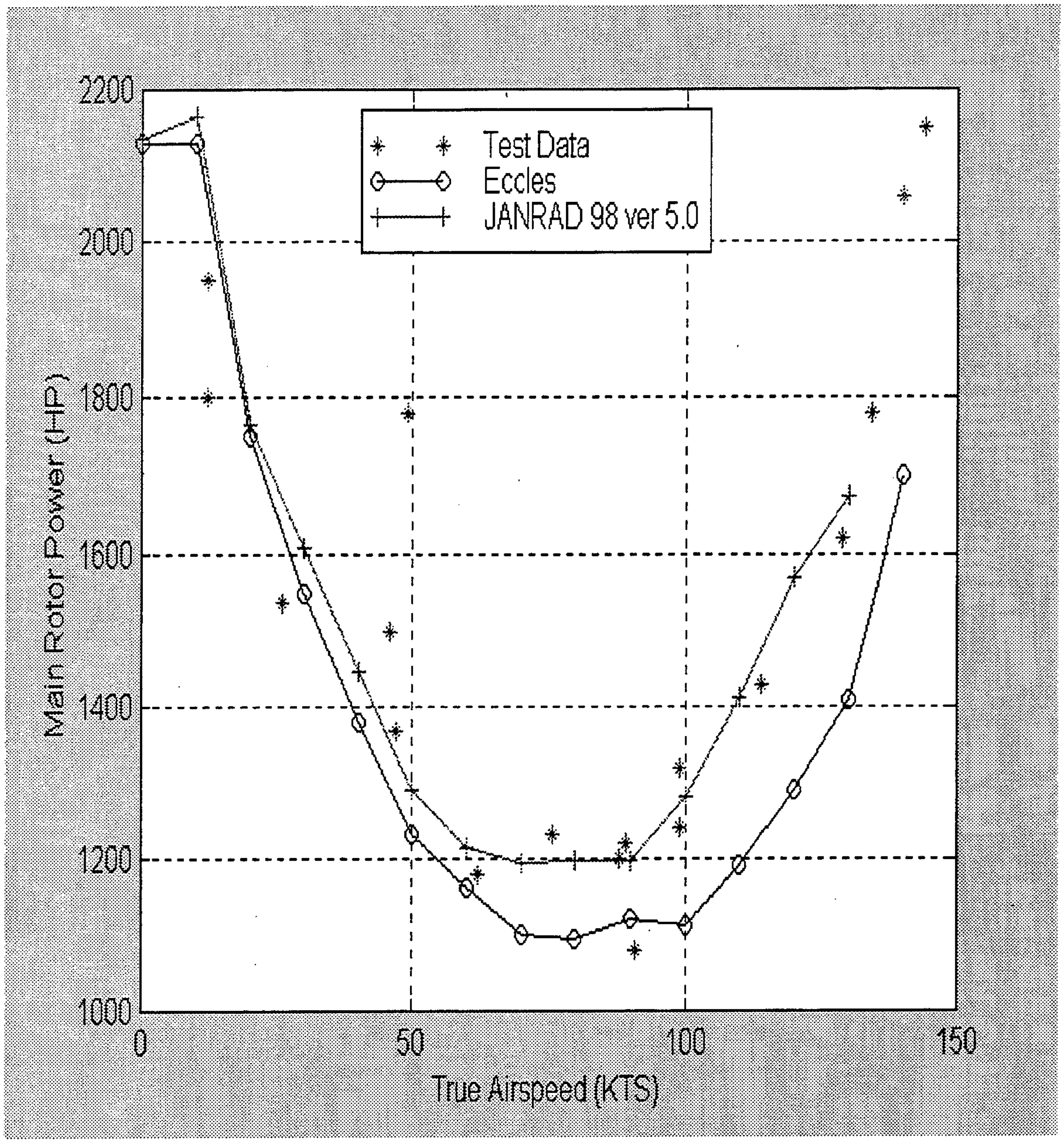


Figure E.4. UH-60A Power Required vs Airspeed, Flight #89

APPENDIX F. LIFT AND THRUST COMPARISON PLOTS

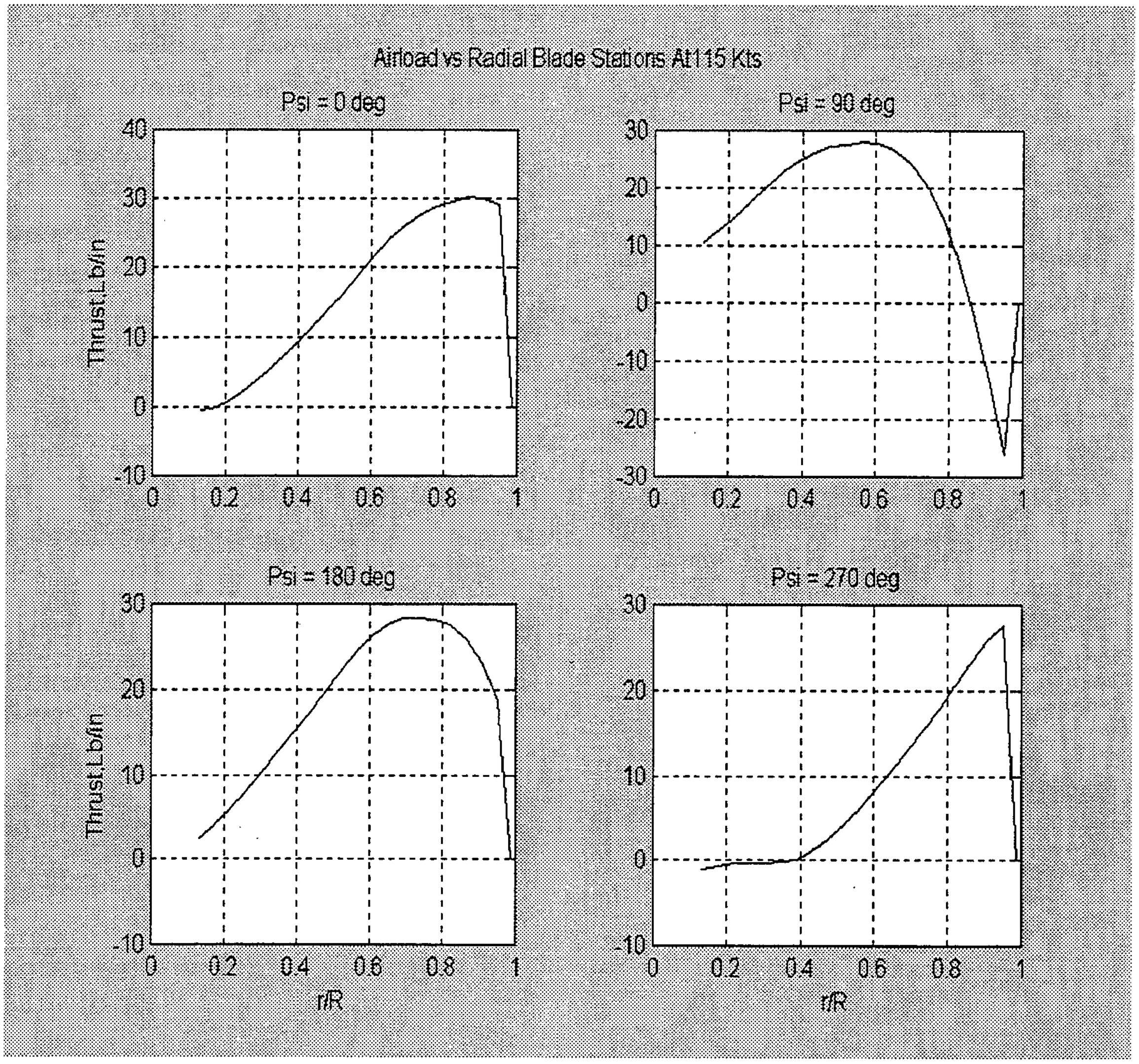


Figure F.1. UH-60A Radial Thrust Distribution at 115 Kts

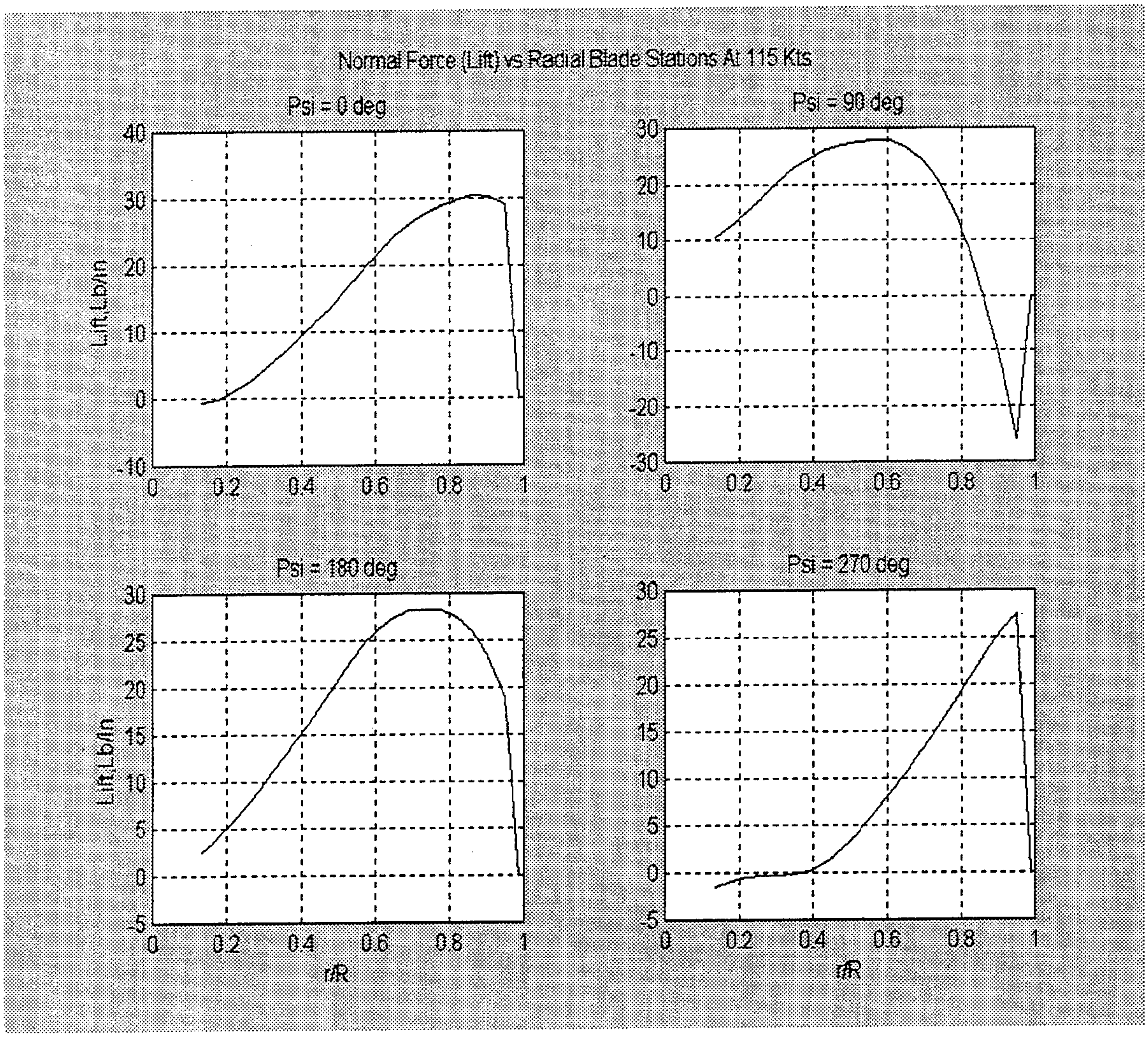


Figure F.2. UH-60A Radial Lift Distribution at 115 Kts

APPENDIX G. JANRAD98.M

This file launches JANRAD 98 and its Graphical User Interface. It is called by typing janrad98 at the MATLAB command line.

```
function janrad98()

%
%           JANRAD98.M

% Joint Army Navy Rotorcraft Analysis and Design
%           (JANRAD)
%           Version 5.0
%           June 1998

%       Version 1.0 Designers
%       MAJ Bob Nicholson
%       MAJ Walter Wirth

%       Version 2.0 Update Designer
%       LT Dale Feddersen

%       Version 3.0 update Designer
%       LT Dave Eccles

%       Version 3.1 update Designer
%       LT Dan Hiatt

%       Version 4.0 update Designer
%       LCDR. Chris F. Lapacik

%   Version 5.0 update Designer
%    LCDR. William L. Hucke
```

% Version 5.0 expanded the capabilities of the Graphical User Interface as well as adding new features to JANRAD 98. These include, user defined blade elements, airfoil meshing, non-linear blade twist, compound helicopter, tail rotor parameters, and output plotroutines for each iteration method. Mach number dependent VR12 and VR15airfoil data was also added. Version 5.0 also added the basic Stability and Control GUI architecture.

% Version 4.0 added the Graphical User Interface. The GUI allows the user to create, run, save and print files with less effort and greater speed. The basic performance calculation routines remain essentially the same as version 3.1. However, the input, output and file structure were modified extensively. Sikorsky H-60 airfoil data was also added.

% Version 3.1 adds time varying tip loss and the corrected dynamics module. The dynamics module provides Southwell plots and rotor blade response in flap and lag motion. Also included is rotor flapping stability determination by Floquet analysis.

```
% Version 2.0 corrected minor bugs in ver 1.0 and incorporated
% Wheatley's Eqn. Additionally the user may now input a
% tapered rotor blade. Finally a menu was created for
% ease of performing various iterations and then saving that
% calculated data for later use/manipulation.

% This program is an interactive preliminary design tool
% developed to aid the design student in determination of
% initial rotorcraft configurations and in the calculation
% of performance, stability and control, and other parameters.
% The program will work for conventional or compound rotorcraft.
% It will provide accurate data for airspeeds less than 10
% knots and greater than or equal to 50 knots.


load janrad98

global H_JAN H_EREF H_CNF

H_JAN = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'MenuBar','none', ...
    'Name','JANRAD 98', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[-0.003125 0.0625 0.954688 0.8625], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_JAN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',16, ...
    'FontWeight','bold', ...
    'Position',[0.0604396 0.757143 0.434066 0.145714], ...
    'String','Welcome to JANRAD 98', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_JAN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',10, ...
    'FontWeight','bold', ...
    'Position',[0.0758597 0.617284 0.403226 0.0925926], ...
    'String','Joint Army/Navy Rotor Analysis and Design', ...
    'Style','text', ...
    'Tag','StaticText7');
b = uicontrol('Parent',H_JAN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
    'Position',[0.0593654 0.392157 0.437052 0.0648567], ...
    'String','Department of Aeronautics & Astronautics', ...
    'FontSize',10, ...
    'FontWeight','bold', ...
    'Style','text', ...
    'Tag','StaticText6');
b = uicontrol('Parent',H_JAN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0766129 0.333333 0.403226 0.0617284], ...
    'String','Naval Postgraduate School', ...
    'FontSize',10, ...
    'FontWeight','bold', ...
    'Style','text', ...
    'Tag','StaticText5');
b = uicontrol('Parent',H_JAN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0766129 0.271605 0.403226 0.0617284], ...
    'String','Monterey,CA 93940', ...
    'FontSize',10, ...
    'FontWeight','bold', ...
    'Style','text', ...
    'Tag','StaticText4');
b = uicontrol('Parent',H_JAN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0766129 0.17284 0.403226 0.0771605], ...
    'String','March 25, 1998', ...
    'FontSize',10, ...
    'FontWeight','bold', ...
    'Style','text', ...
    'Tag','StaticText3');
H_EREF = uicontrol('Parent',H_JAN, ...
    'Units','normalized', ...
    'Callback','janrad98_fcn eref', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.587992 0.655172 0.275362 0.103448], ...
    'String','Edit/Run Existing File', ...
    'Style','radiobutton', ...
    'Tag','Radiobutton1', ...
    'Value',1);
H_CNF = uicontrol('Parent',H_JAN, ...
    'Units','normalized', ...
    'Callback','janrad98_fcn cnf', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.587992 0.514368 0.275362 0.106322], ...
    'String','Create New File', ...
    'Style','radiobutton', ...
    'Tag','Radiobutton2');
b = uicontrol('Parent',H_JAN, ...
    'Units','normalized', ...
    'Callback','janrad98_fcn stop', ...
```

```
        'FontSize',12, ...
        'FontWeight','bold', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.587992 0.295977 0.275362 0.112069], ...
        'String','Quit JANRAD 98', ...
        'Tag','Pushbutton1');
b = uicontrol('Parent',H_JAN, ...
        'Units','normalized', ...
        'Callback','janrad98_fcn cont', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.590062 0.149425 0.273292 0.112069], ...
        'String','Continue >>', ...
        'Tag','Pushbutton2');
b = uicontrol('Parent',H_JAN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'FontWeight','demi', ...
        'Position',[0.591097 0.793103 0.269151 0.091954], ...
        'String','Select Option and Continue', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',H_JAN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.561077 0.445402 0.329193 0.482759], ...
        'Style','frame', ...
        'Tag','Frame1');
b = uicontrol('Parent',H_JAN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0342742 0.570988 0.479839 0.367284], ...
        'Style','frame', ...
    'Tag','Frame2');
b = uicontrol('Parent',H_JAN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0348004 0.149321 0.479017 0.3454], ...
        'Style','frame', ...
        'Tag','Frame3');

assignin('base','H_EREF',H_EREF);
assignin('base','H_CNF',H_CNF);
```

APPENDIX H. JANRAD98_FCN.M

Switchyard Callback function called by the janrad98.m GUI function.

```
function janrad_fcn(Action)

%   Switchyard Callback function for janrad98.m
%   JANRAD 98 VERSION 5.0

global H_EREF H_CNF H_JAN NAME COUNT

cond1=get(H_EREF,'Value');
cond2=get(H_CNF,'Value');

COUNT=0;

if nargin,
  switch Action
  case 'cont',
    if cond1==1
      analysis
      close (H_JAN)
    else,
      NAME=[];
      performance_input
      close (H_JAN)
    end
  case 'stop'
    quit_gui
  case 'eref'
    set(H_EREF,'Value',1)
    set(H_CNF,'Value',0)
  case 'cnf'
    set(H_EREF,'Value',0)
    set(H_CNF,'Value',1)
  end
end
```

APPENDIX I. ANALYSIS.M

This file creates the GUI to select a JANRAD 98 data file and select the analysis method. It is called in the janrad98_fcn.m Switchyard Callback function.

```
function analysis()

%   GUI figure window to Select Type Analysis
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load analysis

global H_P H_SAC H_RD H_ANAL H_LB NAME

H_ANAL = figure('Units','normalized', ...
     'Color',[0.8 0.8 0.8], ...
     'Colormap',mat0, ...
     'Name','Analysis', ...
     'NumberTitle','off', ...
     'PointerShapeCData',mat1, ...
     'Position',[-0.003125 0.0625 0.954688 0.8625], ...
     'Tag','Fig2');
b = uimenu('Parent',H_ANAL, ...
     'Label','JANRAD Options', ...
     'Tag','uimenu1');
c = uimenu('Parent',b, ...
     'Callback','analysis_fcn quit', ...
     'Label','Quit JANRAD', ...
     'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
  'Callback','analysis_fcn return',...
     'Label','Return to Begining', ...
     'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
  'Callback','analysis_fcn delta_input',...
     'Label','Change Input Parameters', ...
     'Tag','Subuimenu1');
c = uimenu('Parent',b, ...
  'Callback','analysis_fcn about',...
  'Label','About Janrad 98 ...', ...
  'Separator','on',...
```

```
    'Tag','Subuimenu1');
b = uicontrol('Parent',H_ANAL, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontWeight','bold', ...
    'Position',[0.106033 0.896175 0.332724 0.0546448], ...
    'String','Type Path to Working Directory', ...
    'Style','text', ...
    'Tag','StaticText2');
H_WORK = uicontrol('Parent',H_ANAL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
  'Position',[0.104205 0.822404 0.330896 0.0546448], ...
  'CreateFcn','',...
  'String',pwd,...
  'HorizontalAlignment','left',...
  'Style','edit', ...
  'Callback','cd(get(H_WORK,"String"));list=dir("*.mat");str={list.name};set(H_LB,"str",str)',...
    'Tag','EditText1');
b = uicontrol('Parent',H_ANAL, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.102377 0.734973 0.340037 0.0628415], ...
    'String','Select Data File', ...
    'Style','text', ...
    'Tag','StaticText3');
H_LB = uicontrol('Parent',H_ANAL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.101786 0.355742 0.342857 0.369748], ...
  'String','', ...
  'CreateFcn','list=dir("*.mat");str={list.name};set(gcbo,"str",str)', ...
  'Style','listbox', ...
  'Callback','global NAME;Value=get(gcbo,"Value");String=get(gcbo,"String");NAME=String{Value};', ...
    'Tag','Listbox1', ...
    'Value',1);
b = uicontrol('Parent',H_ANAL, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.598214 0.815126 0.285714 0.0644258], ...
    'String','Select Type Analysis', ...
    'Style','text', ...
    'Tag','StaticText1');
H_P = uicontrol('Parent',H_ANAL, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Callback','analysis_fcn h_p', ...
    'FontSize',12, ...
    'Position',[0.598214 0.672269 0.285714 0.092437], ...
```

```
        'String','Performance', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton1', ...
        'Value',1);
H_SAC = uicontrol('Parent',H_ANAL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Callback','analysis_fcn h_sac', ...
        'FontSize',12, ...
        'Position',[0.598214 0.540616 0.285714 0.092437], ...
        'String','Stability And Control', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton1');
H_RD = uicontrol('Parent',H_ANAL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Callback','analysis_fcn h_rd', ...
        'FontSize',12, ...
        'Position',[0.598214 0.408964 0.285714 0.0952381], ...
        'String','Rotor Dynamics', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton1');
b = uicontrol('Parent',H_ANAL, ...
        'Units','normalized', ...
        'Callback','analysis_fcn back', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.0982143 0.176 0.210714 0.096], ...
        'String','<< Back', ...
        'Tag','Pushbutton1');
b = uicontrol('Parent',H_ANAL, ...
    'Units','normalized', ...
    'Callback','analysis_fcn cnx',...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.391071 0.176 0.208929 0.096], ...
        'String','Cancel', ...
        'Tag','Pushbutton1');
b = uicontrol('Parent',H_ANAL, ...
        'Units','normalized', ...
        'Callback','global COUNT;COUNT=0;analysis_fcn cont', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.678571 0.178667 0.208929 0.096], ...
        'String','Continue >>', ...
        'Tag','Pushbutton1');
b = uicontrol('Parent',H_ANAL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.557143 0.352941 0.355357 0.557423], ...
        'Style','frame', ...
        'Tag','Frame1');
```

```
assignin('base','H_P',H_P);
assignin('base','H_SAC',H_SAC);
assignin('base','H_RD',H_RD);
assignin('base','H_WORK',H_WORK);
assignin('base','H_LB',H_LB);
assignin('caller','NAME',NAME)
```

APPENDIX J. ANALYSIS_FCN.M

Switchyard Callback function for the analysis.m GUI function.

```
function analysis_fcn(Action)

%   Switchyard Callback function for analysis.m
%   JANRAD 98 VERSION 5.0

global H_P H_SAC H_RD H_ANAL

cond1=get(H_P,'Value');
cond2=get(H_SAC,'Value');
cond3=get(H_RD,'Value');

if nargin,
  switch Action
  case 'h_p'
    set(H_P,'Value',1)
    set(H_SAC,'Value',0)
    set(H_RD,'Value',0)
  case 'h_sac'
    set(H_P,'Value',0)
    set(H_SAC,'Value',1)
    set(H_RD,'Value',0),
  case 'h_rd'
    set(H_P,'Value',0)
    set(H_SAC,'Value',0)
    set(H_RD,'Value',1)
  case 'cont'
    if cond1==1
      performance_inPut
      close (H_ANAL)
    elseif cond2==1
      stability_and_control
    elseif cond3==1
      rotor_dynamics
    else,
      error('SomeThing is Wrong in Analysis Function')
    end
  case 'cnx'
    analysis
    close (gcf)
  case 'back'
    janrad98
    close (H_ANAL)
  case 'return'
    janrad98
    close all
```

```
  case 'quit'
    quit_gui
  case 'delta_input'
    performance_input
    close (H_ANAL)
  case 'about'
    about_janrad
  end
end
```

APPENDIX K. PERFORMANCE_INPUT.M

This file creates the GUI that displays the 36 input parameters as loaded from a previously saved file or created new by user. It is called in the analysis_fcn.m Switchyard Callback function.

```
function performance_input()

%   GUI window to display and/or edit input values.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load performance_input

global COUNT NAME H_PERF_IN S_USER_INPUT S_PERF_INPUT H_MESH H_POP...
  MESH_STA MESH_VAL AF_MAIN AF_TIP H_RADSPC RADSPC_VAL H_TW H_NL_TWIST ...
  NL_TWIST NL_TWIST_VAL

switch COUNT
case 0
  if ~isempty(NAME)
    eval(['load ',NAME])
    unstructure1
  else
    load create_new
    structure
  end
case 1
  unstructure1
end


H_PERF_IN = figure('Units','normalized', ...
  'Color',[0.8 0.8 0.8], ...
  'CreateFcn','global MESH_VAL, MESH_VAL=0;;',...
    'Colormap',mat0, ...
    'Name','Performance Input Parameters', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[-0.003125 0.0625 0.954688 0.8625], ...
    'Tag','Fig2');
```

```
h_opt = uimenu('Parent',H_PERF_IN, ...
    'Label','JANRAD Options', ...
    'Tag','uimenu1');
c = uimenu('Parent',h_opt, ...
    'Callback','performance_input_fcn quit', ...
    'Label','Quit JANRAD', ...
    'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',h_opt, ...
  'Callback','performance_input_fcn return',...
    'Label','Return to Begining', ...
    'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',h_opt, ...
  'Callback','performance_input_fcn delta_input',...
  'Label','Change Input Parameters', ...
  'Enable','off',...
    'Tag','Subuimenu1');
c = uimenu('Parent',h_opt, ...
  'Callback','performance_input_fcn about',...
  'Label','About Janrad 98 ...', ...
  'Separator','on',...
    'Tag','Subuimenu1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0212766 0.92029 0.175123 0.0483092], ...
    'String','Pressure Altitude (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
  'Position',[0.217676 0.922705 0.0981997 0.0483092], ...
  'Style','edit', ...
  'String',PA,...
  'Callback','PA=get(gcbo,"String");S_USER_INPUT.PA=str2num(PA);',...
    'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0212766 0.855072 0.175123 0.0483092], ...
    'String','Temperature (deg F)', ...
    'Style','text', ...
    'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.217676 0.857488 0.0981997 0.0483092], ...
    'Style','edit', ...
  'String',temp,...
  'Callback','temp=get(gcbo,"String");S_USER_INPUT.temp=str2num(temp);',...
    'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
```

```
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0212766 0.792271 0.175123 0.0483092], ...
        'String','Airspeed (kts)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.217676 0.792271 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',Vinf,...
    'Callback','Vinf=get(gcbo,"String");S_USER_INPUT.Vinf=str2num(Vinf);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0212766 0.727053 0.175123 0.0483092], ...
        'String','Gross Wt. (lbs.)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.217676 0.729469 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',GW,...
    'Callback','GW=get(gcbo,"String");S_USER_INPUT.GW=str2num(GW);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0212766 0.661836 0.175123 0.0483092], ...
        'String','Rotor Vel. (rad/sec)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.217676 0.664251 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',omega,...
    'Callback','omega=get(gcbo,"String");S_USER_INPUT.omega=str2num(omega);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0212766 0.596618 0.173486 0.0483092], ...
        'String','No. Azmith Sectors', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
```

```
    'BackgroundColor',[1 1 1], ...
    'Position',[0.217676 0.599034 0.0981997 0.0483092], ...
    'Style','edit', ...
  'String',naz,...
  'Callback','naz=get(gcbo,"String");S_USER_INPUT.naz=str2num(naz);',...
    'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0212766 0.533816 0.175123 0.0483092], ...
    'String','Coll Pitch @ .7 r/R', ...
    'Style','text', ...
    'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.217676 0.536232 0.0981997 0.0483092], ...
    'Style','edit', ...
  'String',thetao,...
  'Callback','thetao=get(gcbo,"String");S_USER_INPUT.thetao=str2num(thetao);',...
    'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0212766 0.468599 0.173486 0.0483092], ...
    'String','Wing Area (ft^2)', ...
    'Style','text', ...
    'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.217676 0.471014 0.0981997 0.0483092], ...
    'Style','edit', ...
  'String',Swing,...
  'Callback','Swing=get(gcbo,"String");S_USER_INPUT.Swing=str2num(Swing);',...
    'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0212766 0.403382 0.173486 0.0483092], ...
    'String','Wing Span (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.217676 0.405797 0.0981997 0.0483092], ...
    'Style','edit', ...
  'String',bwing,...
  'Callback','bwing=get(gcbo,"String");S_USER_INPUT.bwing=str2num(bwing);',...
    'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
```

```
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0212766 0.34058 0.173486 0.0483092], ...
        'String','Expected Wing CL', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.217676 0.342995 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',CLwing,...
    'Callback','CLwing=get(gcbo,"String");S_USER_INPUT.CLwing=str2num(CLwing);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0212766 0.275362 0.173486 0.0483092], ...
        'String','Wing CDo', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.217676 0.277778 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',CDowing,...
    'Callback','CDowing=get(gcbo,"String");S_USER_INPUT.CDowing=str2num(CDowing);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0212766 0.210145 0.173486 0.0483092], ...
    'String','Blade Twist (deg)', ...
        'Style','text', ...
        'Tag','StaticText2');
H_TW = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.217676 0.21256 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',twist,...
    'Callback','twist=get(gcbo,"String");S_USER_INPUT.twist=str2num(twist);',...
        'Tag','EditText1');
H_NL_TWIST = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0562948 0.15083 0.258956 0.0452489], ...
        'String','Select for non-linear Blade Twist', ...
        'Value',0, ...
    'Callback',['global NL_TWIST ;NL_TWIST=[];',...
      'if get(gcbo, "Value")==1,'...
        'set(H_TW,"Enable","off"),',...
      'else,',...
```

```
      'set(H_TW,"Enable","on"),',...
    'end,'],...
  'Style','checkbox', ...
     'Tag','Checkbox3');
d = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.358429 0.922705 0.173486 0.0483092], ...
     'String','Blade Airfoil Type', ...
     'Style','text', ...
     'Tag','StaticText2');
H_POP = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.549918 0.922705 0.125 0.0483092], ...
  'String','0012|HH-02|VR-12|VR-15|SC1094r8|SC1095r8|Airfoil_Mesh', ...
     'Style','popupmenu', ...
  'Tag','PopupMenu1', ...
  'Value',afoil, ...
  'Callback',['afoil=get(gcbo,"Value");S_USER_INPUT.afoil=afoil;global MESH_STA MESH_VAL,',...
    'if get(gcbo, "Value")==7,',...
     'set(H_MESH,"Enable","on"), MESH_VAL=1;',...
    'else,',...
     'set(H_MESH,"Enable","off"),',...
    'end,']);
d = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.359263 0.855204 0.175026 0.0467572], ...
     'String','Begin mesh at (r/R)', ...
  'Style','text', ...
     'Tag','StaticText2');
H_MESH = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
  'BackgroundColor',[1 1 1], ...
  'Position',[0.548618 0.855204 0.09826 0.0482655], ...
  'Style','edit', ...
  'String',MESH_STA,...
  'Enable','off',...
  'Callback',[...
    'MESH_STA=get(gcbo,"String");',...
    'performance_input_fcn mesh'],...
     'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.35824 0.791855 0.175026 0.0467572], ...
     'String','No. Blades', ...
     'Style','text', ...
     'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[1 1 1], ...
```

```
        'Position',[0.549918 0.792271 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',b,...
    'Callback','b=get(gcbo,"String");S_USER_INPUT.b=str2num(b);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.358429 0.731884 0.175123 0.0483092], ...
        'String','Blade Radius (ft.)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.549918 0.729469 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',R,...
    'Callback','R=get(gcbo,"String");S_USER_INPUT.R=str2num(R);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.358429 0.664251 0.175123 0.0483092], ...
        'String','Hinge Offset (ft.)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.549918 0.664251 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',e,...
    'Callback','e=get(gcbo,"String");S_USER_INPUT.e=str2num(e);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.358429 0.601449 0.175123 0.0483092], ...
        'String','Non-Aero Part (ft.)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.549918 0.599034 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',grip,...
    'Callback','grip=get(gcbo,"String");S_USER_INPUT.grip=str2num(grip);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
        'Position',[0.358429 0.538647 0.175123 0.0483092], ...
        'String','Blade Root Chd (ft.)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.549918 0.536232 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',rchord,...
    'Callback','rchord=get(gcbo,"String");S_USER_INPUT.rchord=str2num(rchord);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.358429 0.471014 0.173486 0.0483092], ...
        'String','Blade Taper Ratio', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.549918 0.471014 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',tr,...
    'Callback','tr=get(gcbo,"String");S_USER_INPUT.tr=str2num(tr);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.358429 0.405797 0.175123 0.0483092], ...
        'String','Taper Starts @ (r/R)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.549918 0.405797 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',trst,...
    'Callback','trst=get(gcbo,"String");S_USER_INPUT.trst=str2num(trst);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.358429 0.342995 0.175123 0.0483092], ...
    'String','Wing Eff. Factor - e', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.549918 0.342995 0.0981997 0.0483092], ...
```

```
        'Style','edit', ...
    'String',ewing,...
    'Callback','ewing=get(gcbo,"String");S_USER_INPUT.ewing=str2num(ewing);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.358429 0.280193 0.175123 0.0483092], ...
        'String','Blade Wt-Aero (lbs.)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.549918 0.277778 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',wblade,...
    'Callback','wblade=get(gcbo,"String");S_USER_INPUT.wblade=str2num(wblade);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.358429 0.21256 0.175123 0.0483092], ...
        'String','No. Blade Elements', ...
        'Style','text', ...
        'Tag','StaticText2');
H_NBE = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.549918 0.21256 0.0981997 0.0483092], ...
        'Style','edit', ...
    'String',nbe,...
    'Enable','on',...
    'Callback','nbe=get(gcbo,"String");S_USER_INPUT.nbe=str2num(nbe);',...
    'Tag','EditText1');
H_RADSPC = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.331627 0.15083 0.320368 0.0467572], ...
    'String','Select for uneven radial blade element spacing', ...
    'Value',0, ...
    'Callback',['global NEW_r ;NEW_r=[];',...
      'if get(gcbo, "Value")==1,'...
        'set(H_NBE,"Enable","off"),',...
      'else,',...
        'set(H_NBE,"Enable","on"),',...
      'end,'],...
    'Style','checkbox', ...
    'Tag','Checkbox2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.708291 0.924585 0.172979 0.0482655], ...
```

```
    'String','Blade Lift Curve Slope', ...
    'Style','text', ...
    'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.899693 0.927602 0.09826 0.0482655], ...
    'Style','edit', ...
  'String',a,...
  'Callback','a=get(gcbo,"String");S_USER_INPUT.a=str2num(a);',...
    'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.708291 0.855204 0.175026 0.0482655], ...
    'String','Auxillary Thrust (lbs)', ...
    'Style','text', ...
    'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.902764 0.856712 0.09826 0.0482655], ...
    'Style','edit', ...
  'String',Taux,...
  'Callback','Taux=get(gcbo,"String");S_USER_INPUT.Taux=str2num(Taux);',...
    'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',6, ...
    'Position',[0.708291 0.790347 0.174002 0.0482655], ...
    'String','Flat Plate Area (ft^2)', ...
    'Style','text', ...
    'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.902764 0.791855 0.09826 0.0482655], ...
    'Style','edit', ...
  'String',Afh,...
  'Callback','Afh=get(gcbo,"String");S_USER_INPUT.Afh=str2num(Afh);',...
    'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.708291 0.726998 0.174002 0.0482655], ...
    'String','Vert. Proj Area (ft^2)', ...
    'Style','text', ...
    'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.902764 0.728507 0.09826 0.0482655], ...
```

```
        'Style','edit', ...
    'String',Afv,...
    'Callback','Afv=get(gcbo,"String");S_USER_INPUT.Afv=str2num(Afv);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.708291 0.662142 0.175026 0.0482655], ...
        'String','Vert. Tail Area (ft^2)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.902764 0.66365 0.09826 0.0482655], ...
        'Style','edit', ...
    'String',Svert,...
    'Callback','Svert=get(gcbo,"String");S_USER_INPUT.Svert=str2num(Svert);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.708291 0.597285 0.175026 0.0482655], ...
        'String','Vert. Tail Span (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.902764 0.598793 0.09826 0.0482655], ...
        'Style','edit', ...
    'String',bvert,...
    'Callback','bvert=get(gcbo,"String");S_USER_INPUT.bvert=str2num(bvert);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.708291 0.532428 0.175026 0.0482655], ...
        'String','Vert. Tail CL', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.902764 0.535445 0.09826 0.0482655], ...
        'Style','edit', ...
    'String',CLvert,...
    'Callback','CLvert=get(gcbo,"String");S_USER_INPUT.CLvert=str2num(CLvert);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.708291 0.46908 0.175026 0.0482655], ...
```

```
        'String','Vert. Tail CDo', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.902764 0.470588 0.09826 0.0482655], ...
        'Style','edit', ...
    'String',CDovert,...
    'Callback','CDovert=get(gcbo,"String");S_USER_INPUT.CDovert=str2num(CDovert);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.708291 0.404223 0.175026 0.0482655], ...
        'String','Horiz. Tail Area (ft^2)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.902764 0.405732 0.09826 0.0482655], ...
        'Style','edit', ...
    'String',Shoriz,...
    'Callback','Shoriz=get(gcbo,"String");S_USER_INPUT.Shoriz=str2num(Shoriz);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.708291 0.339367 0.175026 0.0482655], ...
        'String','Horiz. Tail Span (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.902764 0.342383 0.09826 0.0482655], ...
        'Style','edit', ...
    'String',bhoriz,...
    'Callback','bhoriz=get(gcbo,"String");S_USER_INPUT.bhoriz=str2num(bhoriz);',...
        'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.708291 0.276018 0.175026 0.0482655], ...
        'String','Horiz. Tail CL', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.902764 0.277526 0.09826 0.0482655], ...
        'Style','edit', ...
```

```
  'String',CLhoriz,...
  'Callback','CLhoriz=get(gcbo,"String");S_USER_INPUT.CLhoriz=str2num(CLhoriz);',...
     'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.708291 0.211161 0.175026 0.0482655], ...
     'String','Horiz. Tail CDo', ...
     'Style','text', ...
     'Tag','StaticText2');
d = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[1 1 1], ...
     'Position',[0.902764 0.211161 0.09826 0.0482655], ...
     'Style','edit', ...
  'String',CDohoriz,...
  'Callback','CDohoriz=get(gcbo,"String");S_USER_INPUT.CDohoriz=str2num(CDohoriz);',...
     'Tag','EditText1');
d = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.663255 0.155354 0.163767 0.0392157], ...
     'String','Select Tail Rotor Type', ...
     'Style','text', ...
     'Tag','StaticText1');
H_TR_TYPE = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.83521 0.137255 0.158649 0.0558069], ...
  'String','Conventional|Fan_In-Tail|Notar', ...
  'Callback',[...
    'if get(H_TR_TYPE, "Value")==1,'...
    'tailrot=1;'...
    'elseif get(H_TR_TYPE, "Value")==2,'...
    'tailrot=2;'...
    'elseif get(H_TR_TYPE, "Value")==3,'...
    'tailrot=3;'...
    'end,'...
     'S_USER_INPUT.tailrot=tailrot;'],...
     'Style','popupmenu', ...
     'Tag','PopupMenu2', ...
     'Value',1);
H_DISK = uicontrol('Parent',H_PERF_IN, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.663255 0.0935143 0.268168 0.0482655], ...
     'String','Horiz. Tail Under Main Rotor Disk', ...
     'Style','checkbox', ...
  'Tag','Checkbox1', ...
  'Value',0, ...
  'CreateFcn','taildisk=2;', ...
  'Callback',[...
    'if get(H_DISK, "Value")==1,'...
```

```
        'taildisk=1;'...
        'else,'...
        'taildisk=2;'...
        'end,'...
        'S_USER_INPUT.taildisk=taildisk;']);
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
        'Callback','performance_input_fcn back', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.111566 0.00452489 0.163767 0.081448], ...
        'String','<< Back', ...
        'Tag','Pushbutton1');
d = uicontrol('Parent',H_PERF_IN, ...
    'Callback','performance_input_fcn print',...
        'Units','normalized', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.318321 0.00452489 0.163767 0.081448], ...
        'String','Print Screen', ...
        'Tag','Pushbutton2');
d = uicontrol('Parent',H_PERF_IN, ...
    'Callback','performance_input_fcn cnx',...
        'Units','normalized', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.525077 0.00452489 0.163767 0.081448], ...
        'String','Cancel', ...
        'Tag','Pushbutton3');
d = uicontrol('Parent',H_PERF_IN, ...
        'Units','normalized', ...
    'Callback',[ ...
      'global REGIME PICK S_PERF_INPUT RADSPC_VAL NL_TWIST_VAL,PICK=0;REGIME=0;', ...
      'S_PERF_INPUT=S_USER_INPUT;RADSPC_VAL=0;NL_TWIST_VAL=0;',...
      'performance_input_fcn cont'], ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.733879 0.00452489 0.163767 0.081448], ...
    'String','Continue >>', ...
    'Tag','Pushbutton4');

assignin('base','H_DISK',H_DISK);
assignin('base','S_USER_INPUT',S_USER_INPUT);
assignin('base','S_PERF_INPUT',S_PERF_INPUT);
assignin('base','H_NBE',H_NBE);
assignin('base','H_MESH',H_MESH);
assignin('base','H_RADSPC',H_RADSPC);
assignin('base','H_TW',H_TW);
assignin('base','H_NL_TWIST',H_NL_TWIST);
assignin('base','H_TR_TYPE',H_TR_TYPE);
assignin('base','H_POP',H_POP);
```

APPENDIX L. PERFORMANCE_INPUT_FCN.M

Switchyard Callback function for the performance_input.m GUI function.

```
function performance_input_fcn(Action)

% Switchyard Callback function for performance_input.m
% JANRAD 98 VERSION 5.0

global H_PERF_IN H_IT_METH S_PERF_INPUT S_USER_INPUT H_BLD_EL H_AF_MESH
H_RADSPC...
  RADSPC_VAL NEW_r Reff H_NL_TWIST NL_TWIST NL_TWIST_VAL H_COMP_TR ...
  H_AUX_E_DR NEW_AUX_VAL H_FIX_TPP FIX_TPP_VAL S_FIT_TR_INPUT...
  S_NOTAR_TR_INPUT AF_MAIN AF_TIP MESH_STA MESH_VAL

S_USER_INPUT=S_PERF_INPUT;
if nargin,
  switch Action
  case 'cont'
    if isempty(getfield(S_PERF_INPUT,'PA')|...
        getfield(S_PERF_INPUT,'temp')|...
        getfield(S_PERF_INPUT,'Vinf')|...
        getfield(S_PERF_INPUT,'GW')|...
        getfield(S_PERF_INPUT,'omega')|...
        getfield(S_PERF_INPUT,'naz')|...
        getfield(S_PERF_INPUT,'thetao')|...
        getfield(S_PERF_INPUT,'Swing')|...
        getfield(S_PERF_INPUT,'bwing')|...
        getfield(S_PERF_INPUT,'CLwing')|...
        getfield(S_PERF_INPUT,'CDowing')|...
        getfield(S_PERF_INPUT,'ewing')|...
        getfield(S_PERF_INPUT,'afoil')|...
        getfield(S_PERF_INPUT,'a')|...
        getfield(S_PERF_INPUT,'b')|...
        getfield(S_PERF_INPUT,'R')|...
        getfield(S_PERF_INPUT,'e')|...
        getfield(S_PERF_INPUT,'grip')|...
        getfield(S_PERF_INPUT,'rchord')|...
        getfield(S_PERF_INPUT,'tr')|...
        getfield(S_PERF_INPUT,'trst')|...
        getfield(S_PERF_INPUT,'twist')|...
        getfield(S_PERF_INPUT,'wblade')|...
        getfield(S_PERF_INPUT,'nbe')|...
        getfield(S_PERF_INPUT,'Taux')|...
        getfield(S_PERF_INPUT,'Afh')|...
        getfield(S_PERF_INPUT,'Afv')|...
        getfield(S_PERF_INPUT,'Svert')|...
        getfield(S_PERF_INPUT,'bvert')|...
        getfield(S_PERF_INPUT,'CLvert')|...
```

```
        getfield(S_PERF_INPUT,'CDovert')|...
        getfield(S_PERF_INPUT,'Shoriz')|...
        getfield(S_PERF_INPUT,'bhoriz')|...
        getfield(S_PERF_INPUT,'CLhoriz')|...
        getfield(S_PERF_INPUT,'CDohoriz'));
      empty_boxes
    end
    if get(H_RADSPC,'Value')==1
      RADSPC_VAL=1;
    end
    if get(H_NL_TWIST,'Value')==1
      NL_TWIST=1;
    end
      compound_tailrotor
      close (H_PERF_IN)
  case 'cnx'
    performance_input
    close (gcf)
  case 'back'
    analysis
    close (H_PERF_IN)
  case 'print'
    set(gcf,'PaperOrientation','landscape')
    set(gcf,'PaperPosition',[.5 .5 10 7.5])
    print -dwinc
  case 'return'
    janrad98
    close all
  case 'quit'
    quit_gui
  case 'about'
    about_janrad
  case 'mesh'
    airfoil_mesh
  case 'ok'
    close (H_AF_MESH)
  end
end
```

APPENDIX M. PERFORMANCE_OUTPUT.M

This file creates the GUI to display the calculated results from a previously saved input file or newly created user input. It is call in Perf.m.

```
function performance_output()

%   GUI window to display Janrad performance output.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load performance_output

global COUNT H_PERF_OUT S_PERF_OUTPUT S_USER_INPUT H_SAVE ...
  H_datain H_dataout H_vecdata H_check1 H_check2 H_check3 OUT_COUNT

COUNT=1;

H_PERF_OUT = figure('Units','normalized', ...
      'Color',[0.8 0.8 0.8], ...
      'Colormap',mat0, ...
      'Name','Performance Output', ...
      'NumberTitle','off', ...
      'PointerShapeCData',mat1, ...
      'Position',[-0.003125 0.05625 0.954688 0.86875], ...
      'Tag','Fig1');
b = uimenu('Parent',H_PERF_OUT, ...
      'Label','JANRAD Options', ...
      'Tag','uimenu1');
c = uimenu('Parent',b, ...
      'Callback','performance_output_fcn quit', ...
      'Label','Quit JANRAD', ...
      'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
  'Callback','performance_output_fcn return',...
      'Label','Return to Begining', ...
      'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
  'Callback','performance_output_fcn delta_input',...
      'Label','Change Input Parameters', ...
      'Tag','Subuimenu1');
```

```
c = uimenu('Parent',b, ...
  'Callback','performance_output_fcn about',...
  'Label','About Janrad 98 ...', ...
  'Separator','on',...
  'Tag','Subuimenu1');
b = uicontrol('Parent',H_PERF_OUT, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',10, ...
      'Position',[0.0310966 0.925659 0.327332 0.0383693], ...
      'String','Fuselage Drag (lbs.)', ...
      'Style','text', ...
      'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.376432 0.925659 0.0981997 0.0383693], ...
      'String',S_PERF_OUTPUT.Dfuse, ...
      'Style','text', ...
  'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',10, ...
      'Position',[0.0310966 0.872902 0.327332 0.0383693], ...
      'String','Rotor Drag (lbs.)', ...
      'Style','text', ...
      'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'Position',[0.376432 0.872902 0.0981997 0.0383693], ...
      'String',S_PERF_OUTPUT.Hrotor, ...
      'Style','text', ...
      'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',10, ...
      'Position',[0.0310966 0.817746 0.327332 0.0383693], ...
      'String','Wing Lift (lbs.)', ...
      'Style','text', ...
      'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'Position',[0.376432 0.817746 0.0981997 0.0383693], ...
      'String',S_PERF_OUTPUT.Lwing, ...
      'Style','text', ...
      'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
        'FontSize',10, ...
        'Position',[0.0310966 0.76259 0.327332 0.0383693], ...
        'String','Wing Drag (lbs.)', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.376432 0.76259 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.Dwing, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.0310966 0.709832 0.327332 0.0383693], ...
        'String','Horizontal Tail Lift (lbs.)', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.376432 0.707434 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.Lhoriz, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.0310966 0.654676 0.327332 0.0383693], ...
        'String','Horizontal Tail Drag (lbs.)', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.376432 0.654676 0.0981997 0.0383693], ...
    'Style','text', ...
        'String',S_PERF_OUTPUT.Dhoriz', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.0310966 0.59952 0.327332 0.0383693], ...
        'String','Vertical Tail Lift (lbs.)', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
    'Position',[0.376432 0.59952 0.0981997 0.0383693], ...
    'String',S_PERF_OUTPUT.Lvert, ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',10, ...
    'Position',[0.0310966 0.546763 0.327332 0.0383693], ...
    'String','Vertical Tail Drag (lbs.)', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.376432 0.546763 0.0981997 0.0383693], ...
    'String',S_PERF_OUTPUT.Dvert, ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',10, ...
    'Position',[0.0310966 0.491607 0.327332 0.0383693], ...
    'String','Tip Path Angle (deg)', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.376432 0.491607 0.0981997 0.0383693], ...
    'String',S_PERF_OUTPUT.alphaT, ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',10, ...
    'Position',[0.0310966 0.436451 0.327332 0.0383693], ...
    'String','Rotor Coning Angle (deg)', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.376432 0.436451 0.0981997 0.0383693], ...
    'String',S_PERF_OUTPUT.betao, ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',10, ...
```

```
        'Position',[0.0310966 0.383693 0.327332 0.0383693], ...
        'String','Location of Main Thrust (r/R)', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.376432 0.383693 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.rT2, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.0310966 0.328537 0.327332 0.0383693], ...
        'String','1st Lat. Cyclic Term - A1', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.376432 0.328537 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.theta1c, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.0310966 0.273381 0.327332 0.0383693], ...
        'String','1st Long. Cyclic Term - B1', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.376432 0.273381 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.theta1s, ...
        'Style','text', ...
  'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.512275 0.923261 0.327332 0.0383693], ...
        'String','Collective Pitch @ .7 r/R (deg)', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.925659 0.0981997 0.0383693], ...
```

```
    'String',S_PERF_OUTPUT.thetao, ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',10, ...
    'Position',[0.512275 0.870504 0.327332 0.0383693], ...
    'String','Solidity (sigma)', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.859247 0.872902 0.0981997 0.0383693], ...
    'String',S_PERF_OUTPUT.solidity, ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',10, ...
    'Position',[0.512275 0.815348 0.327332 0.0383693], ...
   .'String','Disk Loading (lbs. /ft^2)', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.859247 0.817746 0.0981997 0.0383693], ...
    'String',S_PERF_OUTPUT.DL, ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',10, ...
    'Position',[0.512275 0.760192 0.327332 0.0383693], ...
    'String','Figure of Merit', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.859247 0.76259 0.0981997 0.0383693], ...
    'String',S_PERF_OUTPUT.FM, ...
    'Style','text', ...
  'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',10, ...
    'Position',[0.512275 0.707434 0.327332 0.0383693], ...
```

```
        'String','CT/Sigma', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.709832 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.CT_sig, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.512275 0.652278 0.327332 0.0383693], ...
        'String','CQ/Sigma', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.654676 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.CQ_sig, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.512275 0.597122 0.327332 0.0383693], ...
        'String','CH/Sigma', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.59952 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.CH_sig, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.512275 0.544365 0.327332 0.0383693], ...
        'String','Tip Mach No. of Advancing Blade', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.546763 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.Machtip, ...
```

```
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.512275 0.489209 0.327332 0.0383693], ...
        'String','Advance Ratio', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.491607 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.mu, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.512275 0.434053 0.327332 0.0383693], ...
        'String','Rotor Thrust Required - TPP (lbs.)', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.436451 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.T, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.512275 0.381295 0.327332 0.0383693], ...
        'String','Rotor Power Required (hp)', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.383693 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.Protor, ...
        'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.512275 0.326139 0.327332 0.0383693], ...
        'String','Rotor Torque (ft.-lbs.)', ...
```

```
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.328537 0.0981997 0.0383693], ...
        'String',S_PERF_OUTPUT.Qrotor, ...
        'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.512275 0.270983 0.327332 0.0383693], ...
        'String','Auxilliary Thrust (lbs)', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.859247 0.273381 0.0981997 0.0383693], ...
        'String',S_USER_INPUT.Taux, ...
        'Style','text', ...
        'Tag','StaticText1');
H_check1 = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0310966 0.177458 0.266776 0.0479616], ...
        'String','Save Input Data as ....', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
H_datain = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.302782 0.177458 0.0981997 0.0479616], ...
        'FontSize',12, ...
    'Style','edit', ...
    'String','',...
    'Callback',[...
      'set(gcbo,"String",get(gcbo,"String"));,'...
      'set(H_dataout,"String",get(H_datain,"String"));,'...
      'set(H_vecdata,"String",get(H_datain,"String"));,'...
      'set(H_check1,"Value",1);,'...
      'set(H_check2,"Value",1);,'...
      'set(H_check3,"Value",1);,'],...
    'HorizontalAlignment','right',...
        'Tag','EditText1');
b = uicontrol('Parent',H_PERF_OUT, ...
        'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
        'Position',[0.405892 0.179856 0.0981997 0.0479616], ...
    'Style','text', ...
```

```
  'String','.mat',...
  'HorizontalAlignment','left',...
     'Tag','StaticText2');
H_check2 = uicontrol('Parent',H_PERF_OUT, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.0310966 0.117506 0.266776 0.0479616], ...
     'String','Save Output Data as ....', ...
     'Style','checkbox', ...
     'Tag','Checkbox1');
H_dataout = uicontrol('Parent',H_PERF_OUT, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.302782 0.119904 0.0981997 0.0479616], ...
     'FontSize',12, ...
  'String','',...
  'Style','text', ...
  'HorizontalAlignment','right',...
     'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'FontSize',12, ...
     'Position',[0.405892 0.122302 0.0981997 0.0479616], ...
     'String','.prf', ...
  'HorizontalAlignment','left',...
     'Style','text', ...
     'Tag','StaticText2');
H_check3 = uicontrol('Parent',H_PERF_OUT, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.0310966 0.059952 0.266776 0.0479616], ...
     'String','Save Matrix & Vector Data as ....', ...
     'Style','checkbox', ...
     'Tag','Checkbox1');
H_vecdata = uicontrol('Parent',H_PERF_OUT, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.302782 0.0623501 0.0981997 0.0479616], ...
     'FontSize',12, ...
     'Style','text', ...
  'HorizontalAlignment','right',...
     'Tag','StaticText1');
b = uicontrol('Parent',H_PERF_OUT, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'FontSize',12, ...
     'Position',[0.405892 0.0647482 0.0981997 0.0479616], ...
     'String','_p.mat', ...
  'HorizontalAlignment','left',...
     'Style','text', ...
     'Tag','StaticText2');
b = uicontrol('Parent',H_PERF_OUT, ...
```

```
    'Units','normalized', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.572831 0.146283 0.140753 0.0815348], ...
    'String','<< Back', ...
  'Tag','Pushbutton1',...
  'Callback','performance_output_fcn back');
b = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.749591 0.146283 0.140753 0.0815348], ...
    'String','Options >>', ...
  'Tag','Pushbutton1',...
  'Callback','global OUT_COUNT,OUT_COUNT=0;performance_output_fcn opt');
H_SAVE = uicontrol('Parent',H_PERF_OUT, ...
    'Units','normalized', ...
    'Callback','performance_output_fcn save', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.572178 0.0325048 0.14042 0.0803059], ...
    'String','Save', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',H_PERF_OUT, ...
  'Callback','performance_output_fcn print',...
    'Units','normalized', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.749344 0.0344168 0.17042 0.0803059], ...
    'String','Print Screen', ...
  'Tag','Pushbutton1');

assignin('base','H_datain',H_datain);
assignin('base','H_dataout',H_dataout);
assignin('base','H_vecdata',H_vecdata);
assignin('base','H_check1',H_check1);
assignin('base','H_check2',H_check2);
assignin('base','H_check3',H_check3);
assignin('base','H_SAVE',H_SAVE);
```

APPENDIX N. PERFORMANCE_OUTPUT_FCN.M

Switchyard Callback function for the performacne_output.m GUI function.

```
function performance_output_fcn(Action)

%   Switchyard Callback for performance_output.m
%   JANRAD 98 VERSION 5.0

global H_PERF_OUT S_USER_INPUT S_PERF_INPUT S_PERF_OUTPUT S_MATR_VEC...
  H_datain H_dataout H_vecdata H_check1 H_check2 H_check3 ...
  H_outputfile H_vecfile H_inputfile OUT_COUNT H_SAVE


if nargin
  switch Action
  case 'back'
    close (H_PERF_OUT)
    S_PERF_INPUT=S_USER_INPUT;
    iteration_method
  case 'opt'
    if get(H_check1,'Value')==1
      S_USER_INPUT=S_PERF_INPUT;
      S_USER_INPUT.Vinf=S_USER_INPUT.Vinf/1.68781;
      S_USER_INPUT.thetao=S_USER_INPUT.thetao*57.3;
      S_USER_INPUT.twist=-S_USER_INPUT.twist*57.3;
      filename1=get(H_datain,'String');
      eval(['save ',filename1,' S_USER_INPUT'])
    end
    if get(H_check2,'Value')==1
      filename1=get(H_datain,'String');
      eval(['!copy print_temp1 ', filename1,'.prf'])
    end
    if get(H_check3,'Value')==1
      unstructure3
      filename2=[filename1 '_p'];
      eval(['save ',filename2,' Reff r dr psi vi theta betat alpha Tpsi Npsi Mpsi DMpsi dT dN dM dD cblade
CL CD']);
    end
    options
    set(H_inputfile,'String',[filename1,'.mat'])
    set(H_outputfile,'String',[get(H_dataout,'String'),'.prf'])
    set(H_vecfile,'String',[get(H_vecdata,'String'),'_p.mat'])
    close (H_PERF_OUT)
  case 'save'
    set(H_SAVE,'Enable','off')
    if get(H_check1,'Value')==1
      S_USER_INPUT=S_PERF_INPUT;
      S_USER_INPUT.Vinf=S_USER_INPUT.Vinf/1.68894444;
```

```
      S_USER_INPUT.thetao=S_USER_INPUT.thetao*57.3;
      S_USER_INPUT.twist=-S_USER_INPUT.twist*57.3;
      filename1=get(H_datain,'String');
      eval(['save ',filename1,' S_USER_INPUT'])
    end
    if get(H_check2,'Value')==1
      filename1=get(H_datain,'String');
      eval(['!copy print_temp1 ', filename1,'.prf'])
    end
    if get(H_check3,'Value')==1
      unstructure3
      filename2=[filename1 '_p'];
      eval(['save ',filename2,' Reff r dr psi vi theta betat alpha Tpsi Npsi Mpsi DMpsi dT dN dM dD cblade
CL CD']);
    end
    set(H_SAVE,'Enable','on')
  case 'print'
    set(gcf,'PaperOrientation','landscape')
    set(gcf,'PaperPosition',[.5 .5 10 7.5])
    print -dwinc
  case 'return'
    close all
    janrad98
  case 'delta_input'
    close (H_PERF_OUT)
    performance_input
  case 'quit'
    quit_gui
  case 'about'
    about_janrad
  end
end
```

APPENDIX O. ITERATION_METHOD.M

This file creates GUI to select iteration method and display the status of JANRAD 98 computations. Status comments are set in Trim.m and Perf.m. When computations are complete, this window is closed in Perf.m.

```
function iteration_method()

%   GUI window to select iteration method, start computational routines,
%   and display clock and performance method status.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load iteration_method

global H_IT_METH H_NI H_AS H_AL H_GW H_BT H_BTR H_SOT H_WSA H_RBR H_RBS ...
  H_STATUS H_STATUS1 H_STATUS2 H_STATUS3 H_RADSPC RADSPC_VAL...
  H_GO H_RUPT H_BK H_RES H_MEN r_HOLD...
  COUNT S_USER_INPUT S_PERF_INPUT REGIME PICK ...

COUNT=1; r_HOLD=1;
S_USER_INPUT=S_PERF_INPUT;

H_IT_METH = figure('Units','normalized', ...
  'Color',[0.8 0.8 0.8], ...
     'Colormap',mat0, ...
     'Name','Iteration Method', ...
     'NumberTitle','off', ...
     'PointerShapeCData',mat1, ...
     'Position',[-0.003125 0.0625 0.954688 0.8625], ...
     'Tag','Fig1');
H_MEN = uimenu('Parent',H_IT_METH, ...
     'Label','JANRAD Options', ...
     'Tag','uimenu1');
c = uimenu('Parent',H_MEN, ...
     'Callback','iteration_method_fcn quit', ...
     'Label','Quit JANRAD', ...
     'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',H_MEN, ...
  'Callback','iteration_method_fcn return',...
     'Label','Return to Begining', ...
```

```
      'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',H_MEN, ...
   'Callback','iteration_method_fcn delta_input',...
      'Label','Change Input Parameters', ...
      'Tag','Subuimenu1');
c = uimenu('Parent',H_MEN, ...
   'Callback','iteration_method_fcn about',...
   'Label','About Janrad 98 ...', ...
   'Separator','on',...
      'Tag','Subuimenu1');
f = uicontrol('Parent',H_IT_METH, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',12, ...
      'FontWeight','bold', ...
      'Position',[0.0785714 0.864 0.333333 0.0533333], ...
      'String','Choose Iteration Method', ...
      'Style','text', ...
      'Tag','StaticText1');
H_NI = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn h_ni',...
      'Value',1,...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',12, ...
      'Position',[0.0839304 0.730015 0.333675 0.0527903], ...
      'String','No Iteration', ...
      'Style','radiobutton', ...
      'Tag','Radiobutton1');
H_AS = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn h_as',...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',12, ...
      'Position',[0.0839304 0.671192 0.333675 0.0527903], ...
      'String','Airspeed', ...
      'Style','radiobutton', ...
      'Tag','Radiobutton2');
H_AL = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn h_al',...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',12, ...
      'Position',[0.0839304 0.61086 0.333675 0.0527903], ...
      'String','Altitude', ...
      'Style','radiobutton', ...
      'Tag','Radiobutton3');
H_GW = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn h_gw',...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',12, ...
      'Position',[0.0839304 0.550528 0.333675 0.0527903], ...
```

```
        'String','Gross Weight', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton4');
H_BT = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn h_bt',...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.0839304 0.488688 0.333675 0.0542986], ...
        'String','Blade Twist', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton5');
H_BTR = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn h_btr',...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.0839304 0.426848 0.333675 0.0542986], ...
        'String','Blade Taper Ratio', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton6');
H_SOT = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn h_sot',...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.0839304 0.365008 0.333675 0.0542986], ...
        'String','Start of Taper', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton7');
H_WSA = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn h_wsa',...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.0839304 0.303167 0.333675 0.0542986], ...
        'String','Wing Span Area', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton9');
H_RBR = uicontrol('Parent',H_IT_METH, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Callback','iteration_method_fcn h_rbr', ...
        'FontSize',12, ...
        'Position',[0.0839304 0.242836 0.333675 0.0527903], ...
        'String','Main Rotor Blade Radius', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton10');
H_RBS = uicontrol('Parent',H_IT_METH, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Callback','iteration_method_fcn h_rbs', ...
        'FontSize',12, ...
```

```
        'Position',[0.0839304 0.182504 0.333675 0.0527903], ...
        'String','Main Rotor Speed', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton11');
f = uicontrol('Parent',H_IT_METH, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.482143 0.866667 0.439286 0.0533333], ...
        'String','Analysis Status Box', ...
        'Style','text', ...
        'Tag','StaticText1');
H_STATUS = uicontrol('Parent',H_IT_METH, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.481576 0.690799 0.439099 0.135747], ...
    'Style','text', ...
        'FontSize',12, ...
    'FontWeight','bold', ...
    'HorizontalAlignment','center',...
    'String','',...
        'Tag','StaticText2');
H_STATUS1 = uicontrol('Parent',H_IT_METH, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.483112 0.532428 0.436029 0.140271], ...
    'Style','text', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'HorizontalAlignment','center',...
    'String','',...
        'Tag','StaticText3');
H_STATUS2 = uicontrol('Parent',H_IT_METH, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.484135 0.360483 0.433982 0.15083], ...
    'Style','text', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'HorizontalAlignment','center',...
    'String','',...
        'Tag','StaticText4');
H_STATUS3 = uicontrol('Parent',H_IT_METH, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.483623 0.18552 0.435005 0.152338], ...
        'Style','text', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'HorizontalAlignment','center',...
    'String','',...
    'Tag','StaticText5');
```

```
H_BK = uicontrol('Parent',H_IT_METH, ...
      'Units','normalized', ...
      'Callback','iteration_method_fcn back', ...
      'FontSize',12, ...
      'FontWeight','bold', ...
      'Position',[0.0767857 0.064 0.178571 0.072], ...
      'String','<< Back', ...
      'Tag','Pushbutton1');
H_GO = uicontrol('Parent',H_IT_METH, ...
      'Units','normalized', ...
      'Callback','global PERF_OUTPUT;REGIME=0;iteration_method_fcn anal', ...
      'FontSize',12, ...
      'FontWeight','bold', ...
      'Position',[0.301786 0.0613333 0.178571 0.072], ...
      'String','Analyze', ...
      'Tag','Pushbutton2');
H_RUPT = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn interrupt',...
      'Units','normalized', ...
      'FontSize',12, ...
      'FontWeight','bold', ...
      'Position',[0.528571 0.0613333 0.178571 0.072], ...
      'String','Interrupt', ...
   'Enable','off',...
      'Tag','Pushbutton3');
H_RES = uicontrol('Parent',H_IT_METH, ...
   'Callback','iteration_method_fcn resume',...
      'Units','normalized', ...
      'FontSize',12, ...
      'FontWeight','bold', ...
      'Position',[0.755357 0.0613333 0.178571 0.072], ...
   'String','Resume', ...
   'Enable','off',...
      'Tag','Pushbutton4');
f = uicontrol('Parent',H_IT_METH, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0655067 0.173454 0.37564 0.769231], ...
      'Style','frame', ...
      'Tag','Frame1');
f = uicontrol('Parent',H_IT_METH, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'Position',[0.476786 0.176 0.45 0.768], ...
      'Style','frame', ...
      'Tag','Frame2');

assignin('base','H_NI',H_NI);
assignin('base','H_AS',H_AS);
assignin('base','H_AL',H_AL);
assignin('base','H_GW',H_GW);
assignin('base','H_BT',H_BT);
assignin('base','H_BTR',H_BTR);
```

```
assignin('base','H_SOT',H_SOT);
assignin('base','H_WSA',H_WSA);
assignin('base','H_RBR',H_RBR);
assignin('base','H_RBS',H_RBS);
assignin('base','H_GO',H_GO);
assignin('base','H_RUPT',H_RUPT);
assignin('base','H_BK',H_BK);
assignin('base','H_RES',H_RES);
assignin('base','H_MEN',H_MEN);
```

APPENDIX P. ITERATION_METHOD_FCN.M

Switchyard Callback function for the iteration_method.m GUI function.

```
function iteration_method_fcn(Action)

% Switchyard Callback for iteration_method.m
% JANRAD 98 VERSION 5.0

global H_IT_METH H_NI H_AS H_AL H_GW H_BT H_BTR H_SOT H_WSA H_RBR H_RBS ...
  H_STATUS H_STATUS1 H_STATUS2 H_STATUS3 NEW_r H_MESH H_POP...
  H_GO H_BK H_RES H_RUPT H_MEN RADSPC_VAL H_RADSPC...
  H_HIGE H_IT_BOX H_ASPECT H_ASPECT_EDIT H_NL_TWIST NL_TWIST NL_TWIST_VAL...
  S_PERF_INPUT S_USER_INPUT S_PERF_OUTPUT PICK REGIME H_MESH MESH_VAL...
  MESH_STA AF_MAIN AF_TIP NEW_TPP NEW_AUX_VAL H_FIX_TPP...
  H_AUX_E_DR S_FIT_TR_INPUT S_NOTAR_TR_INPUT FIX_TPP_VAL

if nargin,
  switch Action
  case 'h_ni'
    set(H_NI,'Value',1)
    set(H_AS,'Value',0)
    set(H_AL,'Value',0)
    set(H_GW,'Value',0)
    set(H_BT,'Value',0)
    set(H_BTR,'Value',0)
        set(H_SOT,'Value',0)
    set(H_WSA,'Value',0)
        set(H_RBR,'Value',0)
      set(H_RBS,'Value',0)
   PICK=0;
  case 'h_as'
    set(H_NI,'Value',0)
    set(H_AS,'Value',1)
    set(H_AL,'Value',0)
    set(H_GW,'Value',0)
    set(H_BT,'Value',0)
    set(H_BTR,'Value',0)
        set(H_SOT,'Value',0)
    set(H_WSA,'Value',0)
        set(H_RBR,'Value',0)
      set(H_RBS,'Value',0)
   PICK=1;
  case 'h_al'
    set(H_NI,'Value',0)
    set(H_AS,'Value',0)
    set(H_AL,'Value',1)
    set(H_GW,'Value',0)
    set(H_BT,'Value',0)
    set(H_BTR,'Value',0)
```

```
        set(H_SOT,'Value',0)
    set(H_WSA,'Value',0)
        set(H_RBR,'Value',0)
      set(H_RBS,'Value',0)
  PICK=2;
case 'h_gw'
    set(H_NI,'Value',0)
    set(H_AS,'Value',0)
    set(H_AL,'Value',0)
    set(H_GW,'Value',1)
    set(H_BT,'Value',0)
    set(H_BTR,'Value',0)
        set(H_SOT,'Value',0)
    set(H_WSA,'Value',0)
        set(H_RBR,'Value',0)
      set(H_RBS,'Value',0)
  PICK=3;
case 'h_bt'
    set(H_NI,'Value',0)
    set(H_AS,'Value',0)
    set(H_AL,'Value',0)
    set(H_GW,'Value',0)
    set(H_BT,'Value',1)
    set(H_BTR,'Value',0)
        set(H_SOT,'Value',0)
    set(H_WSA,'Value',0)
        set(H_RBR,'Value',0)
      set(H_RBS,'Value',0)
  PICK=4;
case 'h_btr'
    set(H_NI,'Value',0)
    set(H_AS,'Value',0)
    set(H_AL,'Value',0)
    set(H_GW,'Value',0)
    set(H_BT,'Value',0)
    set(H_BTR,'Value',1)
        set(H_SOT,'Value',0)
    set(H_WSA,'Value',0)
        set(H_RBR,'Value',0)
      set(H_RBS,'Value',0)
  PICK=5;
case 'h_sot'
    set(H_NI,'Value',0)
    set(H_AS,'Value',0)
    set(H_AL,'Value',0)
    set(H_GW,'Value',0)
    set(H_BT,'Value',0)
    set(H_BTR,'Value',0)
        set(H_SOT,'Value',1)
    set(H_WSA,'Value',0)
        set(H_RBR,'Value',0)
      set(H_RBS,'Value',0)
  PICK=6;
```

```
case 'h_wsa'
   set(H_NI,'Value',0)
   set(H_AS,'Value',0)
   set(H_AL,'Value',0)
   set(H_GW,'Value',0)
   set(H_BT,'Value',0)
   set(H_BTR,'Value',0)
        set(H_SOT,'Value',0)
   set(H_WSA,'Value',1)
        set(H_RBR,'Value',0)
     set(H_RBS,'Value',0)
  PICK=7;
case 'h_rbr'
   set(H_NI,'Value',0)
   set(H_AS,'Value',0)
   set(H_AL,'Value',0)
   set(H_GW,'Value',0)
   set(H_BT,'Value',0)
   set(H_BTR,'Value',0)
        set(H_SOT,'Value',0)
  set(H_WSA,'Value',0)
  set(H_RBR,'Value',1)
     set(H_RBS,'Value',0)
        PICK=8;
case 'h_rbs'
   set(H_NI,'Value',0)
   set(H_AS,'Value',0)
   set(H_AL,'Value',0)
   set(H_GW,'Value',0)
   set(H_BT,'Value',0)
   set(H_BTR,'Value',0)
        set(H_SOT,'Value',0)
   set(H_WSA,'Value',0)
     set(H_RBR,'Value',0)
     set(H_RBS,'Value',1)
     PICK=9;
case 'back'
  if RADSPC_VAL==1
    close (H_IT_METH)
    blade_element
  else performance_input
      if get(H_POP,'Value')==7
        set(H_MESH,'Enable','on')
        MESH_VAL=1;
      end
      close (H_IT_METH)
  end
case 'anal'
  set(H_GO,'Enable','off');
  set(H_RUPT,'Enable','on');
  set(H_BK,'Enable','off');
  set(H_RES,'Enable','off');
  set(H_MEN,'Enable','off');
```

```
  if get(H_NI,'Value')==1
    Perf
  elseif get(H_AS,'Value')==1
    iteration_parameters
    set(H_IT_BOX,'String','AIRSPEED')
  elseif get(H_AL,'Value')==1
    iteration_parameters
    set(H_IT_BOX,'String','ALTITUDE')
  elseif get(H_GW,'Value')==1
    iteration_parameters
    if S_PERF_INPUT.PA==0&S_PERF_INPUT.Vinf==0
      set(H_HIGE,'Enable','on')
    end
    set(H_IT_BOX,'String','GROSS WEIGHT')
  elseif get(H_BT,'Value')==1
    iteration_parameters
    set(H_IT_BOX,'String','BLADE TWIST')
  elseif get(H_BTR,'Value')==1
    iteration_parameters
    set(H_IT_BOX,'String','BLADE TAPER RATIO')
  elseif get(H_SOT,'Value')==1
    iteration_parameters
    set(H_IT_BOX,'String','START OF TAPER')
  elseif get(H_WSA,'Value')==1
    iteration_parameters
    set(H_IT_BOX,'String','WING SPAN AREA')
    set(H_ASPECT,'Enable','on')
    set(H_ASPECT_EDIT,'Enable','on')
  elseif get(H_RBR,'Value')==1
    iteration_parameters
    set(H_IT_BOX,'String','ROTOR BLADE RADIUS')
  elseif get(H_RBS,'Value')==1
    iteration_parameters
    set(H_IT_BOX,'String','ROTOR BLADE SPEED(RAD/SEC)')
  end
case 'interrupt'
  set(H_GO,'Enable','off');
  set(H_RUPT,'Enable','off');
  set(H_BK,'Enable','off');
  set(H_RES,'Enable','on');
  set(H_MEN,'Enable','on');
  uiwait;
case 'resume'
  set(H_GO,'Enable','off');
  set(H_RUPT,'Enable','on');
  set(H_BK,'Enable','off');
  set(H_RES,'Enable','off');
  set(H_MEN,'Enable','off');
  uiresume;
case 'quit'
  quit_gui
case 'return'
  close (H_IT_METH)
```

```
  janrad98
 case 'delta_input'
  close (H_IT_METH)
  performance_input
 case 'about'
  about_janrad
 end
end
```

APPENDIX Q. ITERATION_PARAMETERS.M

This file creates GUI to enter iteration parameters. It is called by the Switchyard Callback function iteration_method_fcn.m.

```
function iteration_parameters()

%   GUI window to enter iterative steps.
%   JANRAD 98 VERSION 4.0

% This is the machine-generated representation of a Handle Graphics object
% and its children.  Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

function iteration_parameters()

%   GUI window to enter iterative steps.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children.  Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load iteration_parameters

global H_IP H_HIGE H_IT_BOX H_ASPECT H_ASPECT_EDIT H_MEN H_MINUM H_MAXUM AR


H_IP = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Iteration Parameters', ...
    'NumberTitle','off', ...
    'PoINTERShapeCData',mat1, ...
    'Position',[0.04375 0.0895833 0.875 0.78125], ...
    'Tag','Fig1');
b = uimenu('Parent',H_IP, ...
    'Label','JANRAD Options', ...
    'Tag','uimenu1');
c = uimenu('Parent',b, ...
    'Callback','iteration_parameters_fcn quit', ...
    'Label','Quit JANRAD', ...
    'Tag','JANRAD OptionsSubuimenu1');
```

```
c = uimenu('Parent',b, ...
    'Callback','iteration_parameters_fcn return', ...
    'Label','Return to Begining', ...
    'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
    'Callback','iteration_parameters_fcn delta_input', ...
    'Label','Change Input Parameters', ...
    'Tag','Subuimenu1');
c = uimenu('Parent',b, ...
    'Callback','about_janrad', ...
    'Label','About Janrad 98 ...', ...
    'Separator','on', ...
    'Tag','Subuimenu1');
b = uicontrol('Parent',H_IP, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.260714 0.888 0.476786 0.0533333], ...
    'String','Performance Analysis', ...
    'Style','text', ...
    'Tag','StaticText1');
H_IT_BOX = uicontrol('Parent',H_IP, ...
    'Units','normalized', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.260714 0.824 0.476786 0.0533333], ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_IP, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.2625 0.705778 0.357143 0.0533333], ...
    'String','Start Iteration at :', ...
    'Style','text', ...
    'Tag','StaticText1');
H_MINUM = uicontrol('Parent',H_IP, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.625 0.704 0.107143 0.0533333], ...
  'Style','edit', ...
  'Callback',['global MINUM;MINUM=str2num(get(gcbo,"String"));',...
        'if get(H_AL,"Value")==1&str2num(get(gcbo,"String"))==0|',...
        'get(H_AS,"Value")==1&str2num(get(gcbo,"String"))==0,',...
        'set(H_HIGE,"Enable","on"),end,'],...
  'Tag','EditText1');
b = uicontrol('Parent',H_IP, ...
    'Units','normalized', ...
  'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.2625 0.634667 0.357143 0.0533333], ...
    'String','End Iteration at :', ...
    'Style','text', ...
    'Tag','StaticText1');
H_MAXUM = uicontrol('Parent',H_IP, ...
```

```
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.625 0.634667 0.107143 0.0533333], ...
        'Style','edit', ...
    'Callback','global MAXUM;MAXUM=str2num(get(gcbo,"String"));',...
        'Tag','EditText1');
b = uicontrol('Parent',H_IP, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.2625 0.563556 0.357143 0.0533333], ...
        'String','Iteration Interval :', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',H_IP, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.625 0.562667 0.107143 0.0533333], ...
        'Style','edit', ...
    'Callback','global INTER;INTER=str2num(get(gcbo,"String"));',...
        'Tag','EditText1');
H_ASPECT = uicontrol('Parent',H_IP, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.2625 0.492444 0.355357 0.0533333], ...
        'String','Aspect Ratio :', ...
    'Style','text', ...
    'Enable','off',...
        'Tag','StaticText1');
H_ASPECT_EDIT = uicontrol('Parent',H_IP, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.625 0.490667 0.107143 0.0533333], ...
    'Style','edit', ...
    'Enable','off',...
    'Callback','global AR;AR=str2num(get(gcbo,"String"));',...
        'Tag','EditText1');
H_HIGE = uicontrol('Parent',H_IP, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Enable','off', ...
        'Position',[0.2625 0.421333 0.358929 0.0533333], ...
        'String','Include HIGE Calculations?', ...
    'Style','checkbox', ...
    'Value',0,...
    'Callback','if get(gcbo,"Value")==1,REGIME=1;else,REGIME=0;,end',...
        'Tag','Checkbox1');
b = uicontrol('Parent',H_IP, ...
        'Units','normalized', ...
        'Callback','iteration_parameters_fcn back', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.260714 0.245333 0.196429 0.0986667], ...
        'String','<< BACK', ...
        'Tag','Pushbutton1');
```

```
b = uicontrol('Parent',H_IP, ...
    'Units','normalized', ...
    'Callback','iteration_parameters_fcn anal', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.542857 0.245333 0.196429 0.0986667], ...
    'String','Analyze >>', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',H_IP, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.180357 0.088 0.646429 0.106667], ...
    'String','Warning - Exessive Iteration Limits May Increase Processing Times!', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_IP, ...
    'Units','normalized', ...
  'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.176786 0.0746667 0.655357 0.125333], ...
    'Style','frame', ...
    'Tag','Frame1');
b = uicontrol('Parent',H_IP, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.253571 0.810667 0.498214 0.146667], ...
    'Style','frame', ...
  'Tag','Frame2');

assignin('base','H_HIGE',H_HIGE)
```

APPENDIX R. ITERATION_PARAMETERS_FCN.M

Switchyard Callback function for iteration_parameters.m GUI function.

```
function iteration_parameters_fcn(Action)

%   Switchyard Callback for iteration_parameters.m
%   JANRAD 98 VERSION 5.0

global H_IT_METH H_IP H_NI H_AS H_AL H_GW H_BT H_BTR H_SOT H_WSA H_RBR H_RBS
H_HIGE ...
  H_GO H_BK H_RES H_RUPT H_MEN H_STATUS H_STATUS1 H_STATUS2 H_STATUS3 AR...
  S_USER_INPUT PICK MINUM MAXUM INTER REGIME MESH_VAL MESH_STA AF_MAIN
AF_TIP...
  NEW_TPP NEW_AUX_VAL H_FIX_TPP FIX_TPP_VAL S_FIT_TR_INPUT
S_NOTAR_TR_INPUT...
  NEW_r NL_TWIST NL_TWIST_VAL

if nargin,
  switch Action
  case 'back'
    set(H_BK,'Enable','on');
    set(H_GO,'Enable','on');
    set(H_RUPT,'Enable','off');
    set(H_RES,'Enable','off');
    set(H_MEN,'Enable','on');
    close(H_IP)
  case 'anal'
    set(H_BK,'Enable','off');
    set(H_GO,'Enable','off');
    set(H_RUPT,'Enable','on');
    set(H_RES,'Enable','off');
    set(H_MEN,'Enable','off');
    close(H_IP)
    Perf
  case 'quit'
    quit_gui
  case 'return'
    janrad98
    close(H_IP)
    close (H_IT_METH)
  case 'delta_input'
    performance_input
    close (H_IP)
    close (H_IT_METH)
  case 'about'
    about_janrad
  end
end
```

APPENDIX S. OPTIONS.M

This file creates the GUI to select additional analysis methods and print input and output files saved from the performance output window.

```
function options()

%   GUI window to Select user options at end of performance routine.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load options

global H_OPTIONS H_PSCA H_PRDA H_CIM H_CID H_RTB H_EJANRAD NAME ...
  H_datain H_dataout H_vecdata ...
  H_printin H_printout H_printvec ...
  H_inputfile H_outputfile H_vecfile ...
  H_check1 H_check2 H_check3 filename3 OUT_COUNT

H_OPTIONS = figure('Units','normalized', ...
      'Color',[0.8 0.8 0.8], ...
      'Colormap',mat0, ...
      'Name','Options', ...
      'NumberTitle','off', ...
      'PointerShapeCData',mat1, ...
      'Position',[-0.003125 0.0625 0.954688 0.8625], ...
      'Tag','Fig1');
b = uimenu('Parent',H_OPTIONS, ...
      'Label','JANRAD Options', ...
      'Tag','uimenu1');
c = uimenu('Parent',b, ...
      'Callback','options_fcn quit', ...
      'Label','Quit JANRAD', ...
      'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
  'Callback','options_fcn return',...
      'Label','Return to Begining', ...
      'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
  'Callback','options_fcn delta_input',...
```

```
'Label','Change Input Parameters', ...
   'Tag','Subuimenu1');
c = uimenu('Parent',b, ...
  'Callback','options_fcn about',...
  'Label','About Janrad 98 ...', ...
  'Separator','on',...
   'Tag','Subuimenu1');
b = uicontrol('Parent',H_OPTIONS, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'FontSize',16, ...
   'FontWeight','bold', ...
   'Position',[0.0715631 0.808 0.378531 0.109333], ...
   'String','Select Option', ...
   'Style','text', ...
   'Tag','StaticText1');
H_PSCA = uicontrol('Parent',H_OPTIONS,...
  'Value',1,...
  'Callback','options_fcn h_psca',...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0715631 0.72 0.378531 0.0533333], ...
   'String','Perform Stabilty & Control Analysis', ...
   'Style','radiobutton', ...
   'Tag','Radiobutton3', ...
   'Value',1);
H_PRDA = uicontrol('Parent',H_OPTIONS,...
  'Callback','options_fcn h_prda',...
  'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0715631 0.632 0.378531 0.0533333], ...
   'String','Perform Rotor Dynamics Analysis', ...
   'Style','radiobutton', ...
   'Tag','Radiobutton4');
H_CIM = uicontrol('Parent',H_OPTIONS,...
  'Callback','options_fcn h_cim',...
  'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0715631 0.541333 0.378531 0.0533333], ...
   'String','Change Iteration Method', ...
   'Style','radiobutton', ...
   'Tag','Radiobutton1');
H_CID = uicontrol('Parent',H_OPTIONS,...
  'Callback','options_fcn h_cid',...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0715631 0.453333 0.378531 0.0533333], ...
   'String','Change Input Data', ...
   'Style','radiobutton', ...
   'Tag','Radiobutton2');
H_RTB = uicontrol('Parent',H_OPTIONS,...
  'Callback','options_fcn h_rtb',...
  'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0715631 0.365333 0.378531 0.0533333], ...
```

```
        'String','Return to Begining', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton5');
 H_EJANRAD = uicontrol('Parent',H_OPTIONS,...
   'Callback','options_fcn h_ejanrad',...
   'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0715631 0.274667 0.378531 0.0533333], ...
        'String','Exit JANRAD', ...
        'Style','radiobutton', ...
        'Tag','Radiobutton6');
 b = uicontrol('Parent',H_OPTIONS, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',16, ...
        'FontWeight','bold', ...
        'Position',[0.546139 0.805333 0.376648 0.106667], ...
        'String','Print Selection', ...
        'Style','text', ...
        'Tag','StaticText2');
 H_printin = uicontrol('Parent',H_OPTIONS, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.545548 0.71644 0.169908 0.0527903], ...
        'String','Print Input File :', ...
   'Style','checkbox', ...
        'Tag','Checkbox1', ...
        'Value',0);
 H_inputfile = uicontrol('Parent',H_OPTIONS, ...
        'Units','normalized', ...
        'FontSize',12, ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'String','',...
   'Position',[0.748209 0.71644 0.169908 0.0527903], ...
        'Style','text', ...
        'HorizontalAlignment','left',...
   'Tag','StaticText6');
 H_printout = uicontrol('Parent',H_OPTIONS, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.545548 0.628959 0.169908 0.0527903], ...
        'String','Print Output File :', ...
        'Style','checkbox', ...
        'Tag','Checkbox1', ...
        'Value',0);
 H_outputfile = uicontrol('Parent',H_OPTIONS, ...
        'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'FontSize',12, ...
   'String','',...
   'Position',[0.748209 0.628959 0.169908 0.0527903], ...
        'Style','text', ...
   'HorizontalAlignment','left',...
        'Tag','StaticText8');
 H_printvec = uicontrol('Parent',H_OPTIONS, ...
```

```
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.545548 0.536953 0.169908 0.0527903], ...
      'String','Print Matrix & Vector File :', ...
      'Style','checkbox', ...
      'Tag','Checkbox1', ...
      'Value',0);
H_vecfile = uicontrol('Parent',H_OPTIONS, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',12, ...
   'Position',[0.748209 0.536953 0.169908 0.0527903], ...
   'String','',...
   'Style','text', ...
   'HorizontalAlignment','left',...
      'Tag','StaticText9');
b = uicontrol('Parent',H_OPTIONS, ...
      'Callback','options_fcn print', ...
   'Units','normalized', ...
      'FontSize',12, ...
      'FontWeight','bold', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.595104 0.402667 0.288136 0.072], ...
      'String','Send to Printer', ...
      'Tag','Pushbutton2');
b = uicontrol('Parent',H_OPTIONS, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',18, ...
      'FontWeight','bold', ...
      'Position',[0.564995 0.199095 0.341862 0.0980391], ...
      'String','Plot Selection', ...
      'Style','text', ...
      'Tag','StaticText3');
b = uicontrol('Parent',H_OPTIONS, ...
      'Units','normalized', ...
   'Callback',['if OUT_COUNT==0,',...
     'global filename3,filename3=get(H_vecfile,''String'');end,',...
     'options_fcn plots'],...
   'FontSize',12, ...
      'FontWeight','bold', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.591607 0.102564 0.287615 0.0693816], ...
      'String','Create Plots', ...
      'Tag','Pushbutton3');
b = uicontrol('Parent',H_OPTIONS, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.519774 0.362667 0.435028 0.570667], ...
      'Style','frame', ...
      'Tag','Frame1');
b = uicontrol('Parent',H_OPTIONS, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0451977 0.0826667 0.440678 0.850667], ...
```

```
      'Style','frame', ...
   'Tag','Frame2');
b = uicontrol('Parent',H_OPTIONS, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.516888 0.0799397 0.432958 0.25641], ...
      'Style','frame', ...
      'Tag','Frame3');
b = uicontrol('Parent',H_OPTIONS, ...
      'Callback','options_fcn back', ...
      'Units','normalized', ...
      'FontSize',12, ...
      'FontWeight','bold', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0809793 0.112 0.178908 0.088], ...
      'String','<< Back', ...
      'Tag','Pushbutton1');
b = uicontrol('Parent',H_OPTIONS, ...
   'Callback','options_fcn cont', ...
      'Units','normalized', ...
      'FontSize',12, ...
      'FontWeight','bold', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.286252 0.112 0.177024 0.088], ...
      'String','Continue >>', ...
      'Tag','Pushbutton1');
switch OUT_COUNT
case 0

   if get(H_check1,'Value')==0
     set(H_printin,'Enable','off')
   end
   if get(H_check2,'Value')==0
     set(H_printout,'Enable','off')
   end
   if get(H_check3,'Value')==0
     set(H_printvec,'Enable','off')
   end
 end
assignin('base','H_PSCA',H_PSCA);
assignin('base','H_PRDA',H_PRDA);
assignin('base','H_CIM',H_CIM);
assignin('base','H_CID',H_CID);
assignin('base','H_RTB',H_RTB);
assignin('base','H_EJANRAD',H_EJANRAD);
assignin('base','H_printin',H_printin);
assignin('base','H_printout',H_printout);
assignin('base','H_printvec',H_printvec);
assignin('base','H_inputfile',H_inputfile);
assignin('base','H_outputfile',H_outputfile);
assignin('base','H_vecfile',H_vecfile);
```

APPENDIX T. OPTIONS_FCN.M

Switchyard Callback function for options.m GUI function.

```
function options_fcn(Action)

% Switchyard Callback function for options.m
% JANRAD 98 VERSION 5.0

global H_OPTIONS H_PSCA H_PRDA H_CIM H_CID H_RTB H_EJANRAD ...
  H_printin H_printout H_printvec PICK S_PERF_INPUT NAME...
  S_MATR_VEC H_vecfile print_templ filename3 H_r_VEC


cond1=get(H_PSCA,'Value');
cond2=get(H_PRDA,'Value');
cond3=get(H_CIM,'Value');
cond4=get(H_CID,'Value');
cond5=get(H_RTB,'Value');
cond6=get(H_EJANRAD,'Value');

if nargin
  switch Action
   case 'h_psca'
         set(H_PSCA,'Value',1)
    set(H_PRDA,'Value',0)
    set(H_CIM,'Value',0)
    set(H_CID,'Value',0)
    set(H_RTB,'Value',0)
    set(H_EJANRAD,'Value',0)
  case 'h_prda'
         set(H_PSCA,'Value',0)
    set(H_PRDA,'Value',1)
    set(H_CIM,'Value',0)
    set(H_CID,'Value',0)
    set(H_RTB,'Value',0)
    set(H_EJANRAD,'Value',0)
  case 'h_cim'
         set(H_PSCA,'Value',0)
    set(H_PRDA,'Value',0)
    set(H_CIM,'Value',1)
    set(H_CID,'Value',0)
    set(H_RTB,'Value',0)
    set(H_EJANRAD,'Value',0)
  case 'h_cid'
         set(H_PSCA,'Value',0)
    set(H_PRDA,'Value',0)
    set(H_CIM,'Value',0)
    set(H_CID,'Value',1)
```

```
    set(H_RTB,'Value',0)
    set(H_EJANRAD,'Value',0)
  case 'h_rtb'
        set(H_PSCA,'Value',0)
    set(H_PRDA,'Value',0)
    set(H_CIM,'Value',0)
    set(H_CID,'Value',0)
    set(H_RTB,'Value',1)
    set(H_EJANRAD,'Value',0)
  case 'h_ejanrad'
        set(H_PSCA,'Value',0)
    set(H_PRDA,'Value',0)
    set(H_CIM,'Value',0)
    set(H_CID,'Value',0)
    set(H_RTB,'Value',0)
    set(H_EJANRAD,'Value',1)
  case 'back'
   close (H_OPTIONS)
   performance_output
  case 'print'
   if get(H_printin,'Value')==1,
     eval(['!copy ,print_temp, lpt1'])
     delete print_temp
   end
   if get(H_printout,'Value')==1,
     eval(['!copy ,print_temp1, lpt1'])
     delete print_temp1
   end
   if get(H_printvec,'Value')==1
     eval(['load ',get(H_vecfile,'String')]);
     diary print_temp2
     diary off
     delete print_temp2
     diary print_temp2
     r, Reff, psi, vi, theta, betat, alpha, Tpsi, Npsi, Mpsi, DMpsi, dT, dN, dM, dD, cblade, CL, CD,
     diary off
     eval(['!copy /b ,print_temp2, lpt1'])
     delete print_temp2
   end
  case 'plots'
   if PICK==0
     no_iteration_plots
     set(H_r_VEC,'String',num2str(S_MATR_VEC.r/S_PERF_INPUT.R))
   elseif PICK==1
     airspeed_iteration_plots
   elseif PICK==2
     altitude_iteration_plots
   elseif PICK==3
     grosswt_iteration_plots
   elseif PICK==4
     bladetwist_iteration_plots
   elseif PICK==5
     bladetaperratio_iteration_plots
   elseif PICK==6
```

```
      startoftaper_iteration_plots
    elseif PICK==7
      wingspanarea_iteration_plots
    elseif PICK==8
      rotorrad_iteration_plots
    elseif PICK==9
      rotorspd_iteration_plots
    end
    close (H_OPTIONS)
  case 'cont'
    if cond1==1
      stability_and_control
    elseif cond2==1
      rotor_dynamics
    elseif cond3==1
      close (H_OPTIONS)
      S_PERF_INPUT.Vinf=S_PERF_INPUT.Vinf/1.68894444;
      S_PERF_INPUT.twist=-S_PERF_INPUT.twist*57.3;
      S_PERF_INPUT.thetao=S_PERF_INPUT.thetao*57.3;
      iteration_method
    elseif cond4==1
      close (H_OPTIONS)
      performance_input
    elseif cond5==1
      close (H_OPTIONS)
      janrad98
    elseif cond6==1
      quit_gui
    else,
      error('Something is wrong in Options Function')
    end
  case 'return'
    close all
    janrad98
  case 'delta_input'
    close (H_OPTIONS)
    performance_input
  case 'quit'
    quit_gui
  case 'about'
    about_janrad
  end
end
```

APPENDIX U. BLADE_ELEMENT.M

This file creates a GUI screen allowing uneven blade element and nonlinear twist entries.

```
function blade_element()

% GUI Window to create user defined blade element vector
% JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load blade_element

global S_PERF_INPUT H_BLD_EL NEW_r Reff r_HOLD RADSPC_VAL NL_TWIST_VAL
NEW_AUX_VAL...
  FIX_TPP_VAL NEW_TPP H_EL_1

unstructure
COUNT=1;
rho=.002377*(-.000031*PA+(-.002*temp+1.118))

%   *** first guess at rotor profile drag ( H force) ***

if Vinf < 16.9,

 Drotor=0;

else

 Drotor=Vinf*(rho/.002377);

end
q=0.5*rho*Vinf^2;
Adisk=pi*R^2;
Vtip=omega*R;
temp_rank=temp+459.67;
spd_snd=49.1*sqrt(temp_rank);
%if (Vtip+Vinf)/spd_snd>0.87
%   spd_max=0.87*spd_snd
%   Vtip=spd_max-Vinf
%   omega=Vtip/R

%end

% Section added to set wing lift at a certain value and determine
% the required wing CL      %% This is for compound helos%%
```

```
%if Vinf>=160*1.68781
% perclift= 0.7;
% Lwing=GW*perclift
% CLwing= Lwing/(q*Swing)
%else
% Lwing=q*CLwing*Swing;

%end
Dfuse=q*Afh;

CDwing=CDowing+(CLwing^2/(ewing*pi*(bwing^2/Swing)));

CDhoriz=CDohoriz+(CLhoriz^2/(.8*pi*(bhoriz^2/Shoriz)));

CDvert=CDovert+(CLvert^2/(.8*pi*(bvert^2/Svert)));

Dwing=q*CDwing*Swing;

Dhoriz=q*CDhoriz*Shoriz;

Dvert=q*CDvert*Svert;
if NEW_AUX_VAL==1
  Dftotal=(Dfuse+Dwing+Dhoriz+Dvert);
  if Vinf<16.9
    Taux=0;
  else
    Taux=Dftotal;
  end
  S_PERF_INPUT.Taux=Taux;
  S_USER_INPUT.Taux=Taux;
else
  Dftotal=(Dfuse+Dwing+Dhoriz+Dvert)-Taux;
end
%Lwing=.6*GW
%if S_USER_INPUT.Vinf<80   %80 kts
% Taux=0;
%elseif S_USER_INPUT.Vinf>=140
% Taux=Dftotal;
%else
% Taux=((Vinf-135.02479)/100)*.98747*Dftotal;
%end
Lwing=q*CLwing*Swing;
Lhoriz=q*CLhoriz*Shoriz;
Lvert=q*CLvert*Svert;
Lftotal=Lwing+Lhoriz+Lvert;
if FIX_TPP_VAL==1
  alphaT=NEW_TPP;     %set tip path angle
else
  alphaT=atan2((Dftotal+Drotor),(GW-Lftotal));
end
%alphaT80=0;
%if S_USER_INPUT.Vinf<80
% alphaT=atan2((Dftotal+Drotor),(GW-Lftotal));
%elseif S_USER_INPUT.Vinf==80
% alphaT=atan2((Dftotal+Drotor),(GW-Lftotal));
```

```
% alphaT80=alphaT;
%elseif S_USER_INPUT.Vinf>=140
% alphaT=0;
%else
% alphaT=(1-(((Vinf-135.02479)/100)*.98747))*alphaT80;
%end
%alphaT
mu=Vinf*cos(alphaT)/Vtip;

 %%% account for vertical drag on wing and horizontal tail %%%
    if taildisk==1
      Afv1=Afv+3*(Swing+Shoriz);    % this assumes a vertical Cd of 1.2 for the
    elseif taildisk==2       % wing and horiz tail and a vertical Cd of
      Afv1=Afv+3*Swing      % 0.4 for the fuselage (i.e. 1.2/.4 = 3)
    end                  % thus making wing/tail effectively larger
                   % when hvr thrust calc using Cd=0.4


if Vinf < 16.9,

  T=(1+(0.4*Afv1/Adisk))*GW;
else

  T=(GW-Lftotal)/cos(alphaT)
end

CT=T/(Adisk*rho*Vtip^2);
B=1-(sqrt(2*CT)/b);
Reff=B*R;
r_HOLD=0;

H_BLD_EL = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
  'Name','Blade Element', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.0478516 0.0690104 0.889648 0.877604], ...
    'Tag','Fig1');
H_OPT = uimenu('Parent',H_BLD_EL, ...
    'Label','JANRAD Options', ...
    'Tag','uimenu1');
c = uimenu('Parent',H_OPT, ...
    'Callback','blade_element_fcn quit', ...
    'Label','Quit JANRAD', ...
    'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',H_OPT, ...
    'Callback','blade_element_fcn return', ...
    'Label','Return to Beginning', ...
    'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',H_OPT, ...
    'Callback','blade_element_fcn delta_input', ...
    'Label','Change Input Parameters', ...
    'Tag','Subuimenu1');
c = uimenu('Parent',H_OPT, ...
```

```
        'Callback','blade_element_fcn about', ...
        'Label','About Janrad 98 ...', ...
        'Separator','on', ...
        'Tag','Subuimenu1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'HorizontalAlignment','left', ...
        'Position',[0.0043956 0.799703 0.984615 0.189911], ...
        'String',mat2, ...
        'Style','text', ...
        'Tag','StaticText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'FontWeight','normal', ...
        'Position',[0.116484 0.749258 0.217582 0.041543], ...
        'String',['Grip Ratio = ', num2str(S_PERF_INPUT.grip/R)], ...
        'Style','text', ...
        'Tag','StaticText4');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Units','normalized', ...
        'FontSize',12, ...
        'Position',[0.528571 0.747774 0.347253 0.041543], ...
        'String',['Eff Blade Radius Ratio = ', num2str(Reff/R)], ...
        'Style','text', ...
        'Tag','StaticText4');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.164835 0.695846 0.116484 0.0459941], ...
        'String','Radius (r/R)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.00659341 0.695846 0.145055 0.0445104], ...
        'String','Blade Element', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.298507 0.696481 0.116205 0.0454545], ...
        'String','Twist (deg)', ...
        'Style','text', ...
        'Tag','StaticText2');
```

```
d = uicontrol('Parent',H_BLD_EL, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',12, ...
      'Position',[0.010989 0.642433 0.134066 0.0489614], ...
      'String','1', ...
      'Style','text', ...
      'Tag','StaticText3');
H_EL_1 = uicontrol('Parent',H_BLD_EL, ...
      'Units','normalized', ...
   'BackgroundColor',[1 1 1], ...
      'Position',[0.164835 0.639466 0.117582 0.0519288], ...
   'String',S_PERF_INPUT.grip/R,...
   'Style','edit', ...
      'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
      'Units','normalized', ...
      'BackgroundColor',[1 1 1], ...
      'Position',[0.298507 0.63783 0.117271 0.0513196], ...
   'Callback',['NL_TWIST(1)=str2num(get(gcbo,"String"));',...
     'set(gcbo,"String",NL_TWIST(1)),NL_TWIST_VAL=1;'], ...
      'Style','edit', ...
   'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',12, ...
      'Position',[0.0142857 0.577151 0.131868 0.0459941], ...
      'String','2', ...
      'Style','text', ...
      'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
      'Units','normalized', ...
      'BackgroundColor',[1 1 1], ...
   'Callback',['NEW_r(1)=str2num(get(H_EL_1,"String"));',...
          'NEW_r(2)=str2num(get(gcbo,"String"));',...
          'set(gcbo,"String",NEW_r(2)),RADSPC_VAL=1;'], ...
      'Position',[0.164835 0.571217 0.117582 0.0519288], ...
      'Style','edit', ...
      'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
      'Units','normalized', ...
      'BackgroundColor',[1 1 1], ...
      'Callback','NL_TWIST(2)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(2))', ...
      'Position',[0.298507 0.573314 0.117271 0.0513196], ...
      'Style','edit', ...
      'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
      'Units','normalized', ...
      'BackgroundColor',[0.752941 0.752941 0.752941], ...
      'FontSize',12, ...
      'Position',[0.0142857 0.514837 0.132967 0.0459941], ...
      'String','3', ...
      'Style','text', ...
      'Tag','StaticText3');
```

```
d = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
  'Callback',[...
   'NEW_r(3)=str2num(get(gcbo,"String"));',...
   'set(gcbo,"String",NEW_r(3))'], ...
    'Position',[0.164835 0.508902 0.117582 0.0519288], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','NL_TWIST(3)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(3))', ...
    'Position',[0.298507 0.508798 0.117271 0.0513196], ...
    'Style','edit', ...
    'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.0142857 0.451039 0.131868 0.0489614], ...
    'String','4', ...
    'Style','text', ...
    'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
  'Callback',[...
   'NEW_r(4)=str2num(get(gcbo,"String"));',...
   'set(gcbo,"String",NEW_r(4))'], ...
    'Position',[0.164835 0.448071 0.117582 0.0519288], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','NL_TWIST(4)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(4))', ...
    'Position',[0.298507 0.445748 0.117271 0.0513196], ...
    'Style','edit', ...
    'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.0142857 0.384273 0.131868 0.0504451], ...
    'String','5', ...
    'Style','text', ...
    'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
  'Callback',[...
   'NEW_r(5)=str2num(get(gcbo,"String"));',...
   'set(gcbo,"String",NEW_r(5))'], ...
    'Position',[0.164835 0.382789 0.117582 0.0534125], ...
```

```
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(5)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(5))', ...
        'Position',[0.298507 0.384164 0.117271 0.0527859], ...
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.0153846 0.321958 0.131868 0.0474777], ...
        'String','6', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
      'NEW_r(6)=str2num(get(gcbo,"String"));',...
      'set(gcbo,"String",NEW_r(6))'], ...
        'Position',[0.164835 0.317507 0.117582 0.0534125], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(6)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(6))', ...
        'Position',[0.298507 0.318182 0.117271 0.0527859], ...
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.0142857 0.259644 0.131868 0.0474777], ...
        'String','7', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
      'NEW_r(7)=str2num(get(gcbo,"String"));',...
      'set(gcbo,"String",NEW_r(7))'], ...
        'Position',[0.164835 0.256677 0.117582 0.0534125], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(7)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(7))', ...
        'Position',[0.298507 0.258065 0.117271 0.0527859], ...
```

```
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.0153846 0.197329 0.132967 0.0474777], ...
        'String','8', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
      'NEW_r(8)=str2num(get(gcbo,"String"));',...
      'set(gcbo,"String",NEW_r(8))'], ...
        'Position',[0.164835 0.192878 0.117582 0.0519288], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(8)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(8))', ...
        'Position',[0.298507 0.193548 0.117271 0.0513196], ...
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.0142857 0.132047 0.131868 0.0459941], ...
        'String','9', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
      'NEW_r(9)=str2num(get(gcbo,"String"));',...
      'set(gcbo,"String",NEW_r(9))'], ...
        'Position',[0.164835 0.127596 0.117582 0.0519288], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(9)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(9))', ...
        'Position',[0.298507 0.130499 0.117271 0.0513196], ...
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.0138593 0.0674487 0.132196 0.0483871], ...
```

```
        'String','10', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
      'NEW_r(10)=str2num(get(gcbo,"String"));',...
      'set(gcbo,"String",NEW_r(10))'], ...
        'Position',[0.164835 0.0652819 0.117582 0.0519288], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(10)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(10))', ...
        'Position',[0.298507 0.0674487 0.117271 0.0513196], ...
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.651648 0.695846 0.120879 0.0474777], ...
        'String','Radius (r/R)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.487912 0.697329 0.145055 0.0459941], ...
        'String','Blade Element', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',10, ...
        'Position',[0.794505 0.700297 0.116484 0.0445104], ...
        'String','Twist (deg)', ...
        'Style','text', ...
        'Tag','StaticText2');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.495604 0.64095 0.131868 0.0489614], ...
        'String','11', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
```

```
        'NEW_r(11)=str2num(get(gcbo,"String"));',...
        'set(gcbo,"String",NEW_r(11))'], ...
        'Position',[0.653445 0.63925 0.117954 0.0519481], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(11)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(11))', ...
        'Position',[0.794505 0.64095 0.117582 0.0519288], ...
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.494505 0.577151 0.12967 0.0474777], ...
        'String','12', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
      'NEW_r(12)=str2num(get(gcbo,"String"));',...
      'set(gcbo,"String",NEW_r(12))'], ...
        'Position',[0.653846 0.578635 0.117582 0.0519288], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(12)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(12))', ...
        'Position',[0.794505 0.577151 0.117582 0.0504451], ...
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.494505 0.513353 0.12967 0.0459941], ...
        'String','13', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
      'NEW_r(13)=str2num(get(gcbo,"String"));',...
      'set(gcbo,"String",NEW_r(13))'], ...
        'Position',[0.653846 0.513353 0.117582 0.0519288], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
```

```
     'BackgroundColor',[1 1 1], ...
     'Callback','NL_TWIST(13)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(13))', ...
     'Position',[0.794505 0.511869 0.117582 0.0519288], ...
     'Style','edit', ...
     'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'FontSize',12, ...
     'Position',[0.494505 0.449555 0.12967 0.0489614], ...
     'String','14', ...
     'Style','text', ...
     'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
     'Units','normalized', ...
     'BackgroundColor',[1 1 1], ...
   'Callback',[...
    'NEW_r(14)=str2num(get(gcbo,"String"));',...
    'set(gcbo,"String",NEW_r(14))'], ...
     'Position',[0.653846 0.452522 0.117582 0.0519288], ...
     'Style','edit', ...
     'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
     'Units','normalized', ...
     'BackgroundColor',[1 1 1], ...
     'Callback','NL_TWIST(14)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(14))', ...
     'Position',[0.794505 0.452522 0.117582 0.0504451], ...
     'Style','edit', ...
     'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'FontSize',12, ...
     'Position',[0.495604 0.385757 0.12967 0.0504451], ...
     'String','15', ...
     'Style','text', ...
     'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
     'Units','normalized', ...
     'BackgroundColor',[1 1 1], ...
   'Callback',[...
    'NEW_r(15)=str2num(get(gcbo,"String"));',...
    'set(gcbo,"String",NEW_r(15)),'], ...
     'Position',[0.653846 0.388724 0.117582 0.0534125], ...
     'Style','edit', ...
     'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
     'Units','normalized', ...
     'BackgroundColor',[1 1 1], ...
     'Callback','NL_TWIST(15)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(15))', ...
     'Position',[0.795604 0.390208 0.117582 0.0534125], ...
     'Style','edit', ...
     'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
     'Units','normalized', ...
```

```
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.495604 0.321958 0.12967 0.0474777], ...
    'String','16', ...
    'Style','text', ...
    'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
  'Callback',[...
   'NEW_r(16)=str2num(get(gcbo,"String"));',...
   'set(gcbo,"String",NEW_r(16))'], ...
    'Position',[0.653846 0.323442 0.117582 0.0504451], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','NL_TWIST(16)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(16))', ...
    'Position',[0.794505 0.324926 0.117582 0.0519288], ...
    'Style','edit', ...
    'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.495604 0.261128 0.12967 0.0474777], ...
    'String','17', ...
    'Style','text', ...
    'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
  'Callback',[...
   'NEW_r(17)=str2num(get(gcbo,"String"));',...
   'set(gcbo,"String",NEW_r(17))'], ...
    'Position',[0.653846 0.262611 0.117582 0.0534125], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','NL_TWIST(17)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(17))', ...
    'Position',[0.794505 0.264095 0.117582 0.0534125], ...
    'Style','edit', ...
    'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.494505 0.200297 0.12967 0.0459941], ...
    'String','18', ...
    'Style','text', ...
    'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
```

```
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
        'NEW_r(18)=str2num(get(gcbo,"String"));',...
        'set(gcbo,"String",NEW_r(18))'], ...
        'Position',[0.653846 0.198813 0.117582 0.0519288], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(18)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(18))', ...
        'Position',[0.794505 0.20178 0.117582 0.0504451], ...
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.495604 0.137982 0.12967 0.0459941], ...
        'String','19', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
        'NEW_r(19)=str2num(get(gcbo,"String"));',...
        'set(gcbo,"String",NEW_r(19))'], ...
        'Position',[0.653846 0.137982 0.117582 0.0519288], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','NL_TWIST(19)=str2num(get(gcbo,"String"));set(gcbo,"String",NL_TWIST(19))', ...
        'Position',[0.794505 0.139466 0.117582 0.0519288], ...
        'Style','edit', ...
        'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.494505 0.0712166 0.130769 0.0504451], ...
        'String','20', ...
        'Style','text', ...
        'Tag','StaticText3');
d = uicontrol('Parent',H_BLD_EL, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
    'Callback',[...
        'NEW_r(20)=str2num(get(gcbo,"String"));',...
        'set(gcbo,"String",NEW_r(20))'], ...
        'Position',[0.653846 0.0727003 0.117582 0.0519288], ...
        'Style','edit', ...
```

```
       'Tag','EditText1');
b = uicontrol('Parent',H_BLD_EL, ...
       'Units','normalized', ...
       'BackgroundColor',[1 1 1], ...
       'Callback','NL_TWIST(20)=str2num(get(gcbo,''String''));set(gcbo,''String'',NL_TWIST(20))', ...
       'Position',[0.794505 0.0771513 0.117582 0.0504451], ...
       'Style','edit', ...
       'Tag','EditText1');
d = uicontrol('Parent',H_BLD_EL, ...
       'Units','normalized', ...
       'Callback','blade_element_fcn back', ...
       'BackgroundColor',[0.752941 0.752941 0.752941], ...
       'FontSize',12, ...
       'FontWeight','bold', ...
       'Position',[0.153677 0.00593472 0.198683 0.0548961], ...
       'String','<< Back', ...
       'Tag','Pushbutton2');
d = uicontrol('Parent',H_BLD_EL, ...
       'Units','normalized', ...
   'Callback',[...
    'if RADSPC_VAL==1,S_PERF_INPUT.nbe=length(NEW_r);end,', ...
    'blade_element_fcn cont'],...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'FontSize',12, ...
       'FontWeight','bold', ...
       'Position',[0.649835 0.0074184 0.203074 0.0563798], ...
       'String','Continue', ...
       'Tag','Pushbutton1');

assignin('base','Reff',Reff);
assignin('base','H_EL_1',H_EL_1);
```

APPENDIX V. BLADE_ELEMENT_FCN.M

Switchyard Callback function for blade_element.m GUI function.

```
function blade_element_fcn(Action)

%  Switchyard Callback function for blade_element.m
%  JANRAD 98 VERSION 5.0

global S_PERF_INPUT H_BLD_EL NEW_r Reff r_HOLD RADSPC_VAL NL_TWIST_VAL H_MESH
H_POP...
  AF_MAIN AF_TIP MESH_VAL MESH_STA NEW_AUX_VAL FIX_TPP_VAL NEW_TPP

if nargin,
  switch Action
  case 'return'
    janrad98
    close(H_BLD_EL)
  case 'quit'
    quit_gui
  case 'about'
    about_janrad
  case 'delta_input'
    performance_input
    if get(H_POP,'Value')==7
      set(H_MESH,'Enable','on')
    end
    close(H_BLD_EL)
  case 'cont'
    count=0;
    for i=1:length(NEW_r)
      if NEW_r(i)>(Reff/S_PERF_INPUT.R)
        count=count+1;
      end
    end
      if count>=1
        r_warning
      else iteration_method
        close (H_BLD_EL)
      end
  case 'back'
    performance_input
    if get(H_POP,'Value')==7
      set(H_MESH,'Enable','on')
    end
    close(H_BLD_EL)
  end
end
```

APPENDIX W. COMPOUND_TAILROTOR.M

This file creates a figure window allowing insertion of compound helicopter and tail rotor parameters

```
function compound_tailrotor()

% GUI Window to enter compound helo and tail rotor parameters
% JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load compound_tailrotor

global H_COMP_TR H_AUX_E_DR H_FIX_TPP NEW_AUX_VAL NEW_TPP S_USER_INPUT
S_PERF_INPUT COUNT ...
  MESH_VAL

unstructure1
COUNT=1;
H_COMP_TR = figure('Units','normalized', ...
      'Color',[0.8 0.8 0.8], ...
      'Colormap',mat0, ...
  'Name','Compound Helicopter & Tail Rotor Parameters', ...
  'Createfcn','global S_CON_TR_INPUT',...
      'NumberTitle','off', ...
      'PointerShapeCData',mat1, ...
      'Position',[0.00878906 0.0690104 0.899414 0.852865], ...
      'Tag','Figure');
d = uimenu('Parent',H_COMP_TR, ...
      'Label','JANRAD Options', ...
      'Tag','uimenu1');
c = uimenu('Parent',d, ...
      'Callback','compound_tailrotor_fcn quit', ...
      'Label','Quit JANRAD', ...
      'Tag','Subuimenu1');
c = uimenu('Parent',d, ...
  'Callback','compound_tailrotor_fcn return',...
      'Label','Return to Begining', ...
      'Tag','Subuimenu1');
c = uimenu('Parent',d, ...
  'Callback','compound_tailrotor_fcn delta_input',...
  'Label','Change Input Parameters', ...
      'Tag','Subuimenu1');
c = uimenu('Parent',d, ...
  'Callback','compound_tailrotor_fcn about',...
  'Label','About Janrad 98 ...', ...
```

```
'Separator','on',...
   'Tag','Subuimenu1');
b = uicontrol('Parent',H_COMP_TR, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'FontSize',10, ...
   'Position',[0.0412595 0.833588 0.408252 0.149618], ...
   'String','COMPOUND HELICOPTER OR COMPOUND HELICOPTER WITH AUXILIARY
THRUST', ...
   'Style','text', ...
   'Tag','StaticText1');
H_FIX_TPP = uicontrol('Parent',H_COMP_TR, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Callback','global FIX_TPP_VAL', ...
   'Position',[0.0412595 0.743511 0.309446 0.0625954], ...
   'String','SELECT TO FIX TIP PATH PLANE ANGLE', ...
   'Style','checkbox', ...
   'Tag','Checkbox1');
b = uicontrol('Parent',H_COMP_TR, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0401737 0.674809 0.184582 0.0473282], ...
   'String','Tip Path Plane Angle = ', ...
   'Style','text', ...
   'Tag','StaticText2');
b = uicontrol('Parent',H_COMP_TR, ...
   'Units','normalized', ...
   'BackgroundColor',[1 1 1], ...
   'Callback','global NEW_TPP,NEW_TPP=str2num(get(gcbo,"String"));', ...
   'Position',[0.233442 0.671756 0.0879479 0.0503817], ...
   'Style','edit', ...
   'Tag','EditText1');
b = uicontrol('Parent',H_COMP_TR, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.327904 0.671756 0.0705755 0.0473282], ...
   'String','radians', ...
   'Style','text', ...
   'Tag','StaticText3');
H_AUX_E_DR = uicontrol('Parent',H_COMP_TR, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Callback','global NEW_AUX_VAL,', ...
   'Position',[0.019544 0.557252 0.450597 0.0717557], ...
   'String','SELECT TO SET AUXILIARY THRUST EQUAL TO TOTAL DRAG', ...
   'Style','checkbox', ...
   'Tag','Checkbox2');
b = uicontrol('Parent',H_COMP_TR, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
   'Position',[0.0282302 0.480916 0.42671 0.0610687], ...
   'String',mat2, ...
   'Style','text', ...
 'Tag','StaticText4');
```

```
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.00977199 0.436641 0.473398 0.555725], ...
    'Style','frame', ...
    'Tag','Frame1');

%%%%%%%%%%%%%%%%%%%%%%%%%
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'Position',[0.565689 0.91145 0.407166 0.070229], ...
    'String','TAIL ROTOR SIZING PARAMETERS', ...
    'Style','text', ...
    'Tag','StaticText5');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.565689 0.833588 0.407166 0.0717557], ...
    'String','Note:  Fill In The Information Pertinent To Your Desired Tail Rotor Type', ...
    'Style','text', ...
    'Tag','StaticText6');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontWeight','bold', ...
    'Position',[0.661238 0.775573 0.241042 0.0427481], ...
    'String','CONVENTIONAL TAIL ROTOR', ...
    'Style','text', ...
    'Tag','StaticText7');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.564604 0.723664 0.102063 0.0305344], ...
    'String','Radius (ft)', ...
    'Style','text', ...
    'Tag','StaticText10');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
  'Position',[0.679696 0.722137 0.0760043 0.0305344], ...
  'Callback','CON_R=get(gcbo,''String'');S_USER_INPUT.CON_R=str2num(CON_R);',...
  'String',CON_R,...
  'Style','edit', ...
    'Tag','EditText2');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.774159 0.717557 0.108578 0.0366412], ...
    'String','Blade Chord (ft)', ...
  'Style','text', ...
    'Tag','StaticText13');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
```

```
        'BackgroundColor',[1 1 1], ...
        'Position',[0.897937 0.719084 0.0781759 0.0305344], ...
    'Callback','CON_chord=get(gcbo,"String");S_USER_INPUT.CON_chord=str2num(CON_chord);',...
    'String',CON_chord,...
    'Style','edit', ...
        'Tag','EditText4');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.562432 0.658015 0.103149 0.0305344], ...
        'String','# of Blades', ...
        'Style','text', ...
        'Tag','StaticText11');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.679696 0.656489 0.0770901 0.0305344], ...
    'Callback','CON_b=get(gcbo,"String");S_USER_INPUT.CON_b=str2num(CON_b);',...
    'String',CON_b,...
    'Style','edit', ...
        'Tag','EditText3');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.774159 0.638168 0.112921 0.059542], ...
        'String',' Rotor Velocity (rad/sec)', ...
        'Style','text', ...
        'Tag','StaticText12');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.897937 0.651908 0.0770901 0.0305344], ...
    'Callback','CON_omega=get(gcbo,"String");S_USER_INPUT.CON_omega=str2num(CON_omega);',...
    'String',CON_omega,...
    'Style','edit', ...
        'Tag','EditText5');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.564604 0.596947 0.103149 0.0305344], ...
        'String','Blade cd', ...
        'Style','text', ...
        'Tag','StaticText14');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.679696 0.593893 0.0770901 0.0305344], ...
    'Callback','CON_cd=get(gcbo,"String");S_USER_INPUT.CON_cd=str2num(CON_cd);',...
    'String',CON_cd,...
    'Style','edit', ...
        'Tag','EditText6');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.773073 0.572519 0.114007 0.0534351], ...
```

```
    'String','Tail Moment Arm (ft)', ...
    'Style','text', ...
    'Tag','StaticText15');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.897937 0.584733 0.0770901 0.0305344], ...
  'Callback','CON_lt=get(gcbo,"String");S_USER_INPUT.CON_lt=str2num(CON_lt);',...
  'String',CON_lt,...
  'Style','edit', ...
    'Tag','EditText7');
%%%%%%%%%%%%%%%%%%%%%%%%%%
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontWeight','bold', ...
    'Position',[0.662324 0.494656 0.241042 0.0427481], ...
    'String','FAN-IN-TAIL', ...
    'Style','text', ...
    'Tag','StaticText8');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.565689 0.454962 0.102063 0.0305344], ...
    'String','Radius (ft)', ...
    'Style','text', ...
    'Tag','StaticText10');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.680782 0.451908 0.0792617 0.0305344], ...
  'Callback','S_FIT_TR_INPUT.FIT_R=str2num(get(gcbo,"String"));',...
  'Style','edit', ...
    'Tag','EditText2');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.774159 0.424427 0.112921 0.059542], ...
    'String',' Rotor Velocity (rad/sec)', ...
    'Style','text', ...
    'Tag','StaticText12');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.897937 0.441221 0.0770901 0.0305344], ...
  'Callback','S_FIT_TR_INPUT.FIT_omega=str2num(get(gcbo,"String"));',...
  'Style','edit', ...
    'Tag','EditText5');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.566775 0.384733 0.103149 0.0305344], ...
    'String','Blade cd', ...
    'Style','text', ...
    'Tag','StaticText14');
```

```
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.681868 0.383206 0.0781759 0.0320611], ...
  'Callback','S_FIT_TR_INPUT.FIT_cd=str2num(get(gcbo,"String"));',...
  'Style','edit', ...
    'Tag','EditText3');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.771987 0.363359 0.114007 0.0534351], ...
    'String','Tail Moment Arm (ft)', ...
    'Style','text', ...
    'Tag','StaticText15');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.896851 0.375573 0.0770901 0.0305344], ...
    'Callback','S_FIT_TR_INPUT.FIT_lt=str2num(get(gcbo,"String"));',...
  'Style','edit', ...
    'Tag','EditText7');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.566775 0.331298 0.103149 0.0305344], ...
    'String','Solidity', ...
    'Style','text', ...
  'Tag','StaticText14');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.681868 0.329771 0.0781759 0.0320611], ...
    'Callback','S_FIT_TR_INPUT.FIT_sigma=str2num(get(gcbo,"String"));',...
  'Style','edit', ...
    'Tag','EditText3');

%%%%%%%%%%%%%%%%%%%%%%%%%%%%

b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontWeight','bold', ...
    'Position',[0.663409 0.259542 0.239957 0.0412214], ...
    'String','NOTAR', ...
    'Style','text', ...
    'Tag','StaticText9');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.567861 0.21374 0.102063 0.0305344], ...
    'String','Diameter (ft)', ...
    'Style','text', ...
    'Tag','StaticText10');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
```

```
        'BackgroundColor',[1 1 1], ...
        'Position',[0.677524 0.21374 0.0770901 0.0320611], ...
        'Style','edit', ...
        'Tag','EditText2');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.773073 0.20916 0.108578 0.0381679], ...
        'String','RPM', ...
        'Style','text', ...
        'Tag','StaticText13');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.900109 0.210687 0.0781759 0.0305344], ...
        'Style','edit', ...
        'Tag','EditText4');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.567861 0.145038 0.103149 0.0320611], ...
        'String','# of Blades', ...
        'Style','text', ...
        'Tag','StaticText11');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.677524 0.143511 0.0770901 0.0335878], ...
        'Style','edit', ...
        'Tag','EditText3');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.770901 0.128244 0.112921 0.0625954], ...
        'String',' Thruster Exit Area (ft^2)', ...
        'Style','text', ...
        'Tag','StaticText12');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.900109 0.141985 0.0770901 0.0320611], ...
        'Style','edit', ...
        'Tag','EditText5');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.568947 0.0793893 0.103149 0.0305344], ...
        'String','Solidity', ...
        'Style','text', ...
        'Tag','StaticText14');
b = uicontrol('Parent',H_COMP_TR, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Position',[0.677524 0.0793893 0.0781759 0.0305344], ...
        'Style','edit', ...
```

```
    'Tag','EditText6');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.770901 0.0580153 0.114007 0.0534351], ...
    'String','NOTAR Moment Arm (ft)', ...
    'Style','text', ...
    'Tag','StaticText15');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.897937 0.0717557 0.0770901 0.0305344], ...
    'Style','edit', ...
    'Tag','EditText7');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.558089 0.010687 0.429967 0.983206], ...
    'Style','frame', ...
    'Tag','Frame2');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'Callback','compound_tailrotor_fcn back', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.149837 0.242378 0.206298 0.106707], ...
    'String','BACK', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',H_COMP_TR, ...
    'Units','normalized', ...
    'Callback','S_PERF_INPUT=S_USER_INPUT;compound_tailrotor_fcn cont', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.152009 0.0960366 0.206298 0.105183], ...
    'String','CONTINUE >>', ...
    'Tag','Pushbutton1');

assignin('base','H_AUX_E_DR',H_AUX_E_DR)
assignin('base','H_FIX_TPP',H_FIX_TPP)
```

APPENDIX X. COMPOUND_TAILROTOR_FCN.M

Switchyard callback for compound_tailrotor.m GUI screen

```
function compound_tailrotor_fcn(Action)

%   Switchyard Callback function for compound_tailrotor.m
%   JANRAD 98 VERSION 5.0

global H_PERF_IN H_COMP_TR H_AUX_E_DR H_FIX_TPP NEW_AUX_VAL NEW_TPP
FIX_TPP_VAL RADSPC_VAL ...
    COUNT S_USER_INPUT S_PERF_INPUT H_POP AF_MAIN AF_TIP MESH_VAL MESH_STA
NEW_r NL_TWIST

if nargin,
  switch Action
  case 'back'
    performance_input
    if get(H_POP,'Value')==7
      set(H_MESH,'Enable','on')
      MESH_VAL=1;
    end
    close (H_COMP_TR)
  case 'return'
    janrad98
    close all
  case 'quit'
    quit_gui
  case 'delta_input'
    performance_input
    if get(H_POP,'Value')==7
      set(H_MESH,'Enable','on')
      MESH_VAL=1;
    end
    close (H_COMP_TR)
  case 'about'
    about_janrad
  case 'cont'
    if get(H_AUX_E_DR,'Value')==1
      NEW_AUX_VAL=1;
    else
      NEW_AUX_VAL=0;
    end
    if get(H_FIX_TPP,'Value')==1
      FIX_TPP_VAL=1;
    else
      FIX_TPP_VAL=0;
    end
    if RADSPC_VAL==1|NL_TWIST==1
      blade_element
      close (H_COMP_TR)
    else
      iteration_method
      close (H_COMP_TR)
```

```
    end
  end
end
```

APPENDIX Y. AIRFOIL_MESH.M

This file creates a screen allowing airfoil meshing capabilities

```
function airfoil_mesh()

% GUI Window to create mesh of two airfoils
% JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load airfoil_mesh

global H_AF_MESH H_MESH AF_MAIN AF_TIP MESH_STA MESH_VAL COUNT

COUNT=1;
H_AF_MESH = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Airfoil_Mesh', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.169922 0.532552 0.65625 0.389323], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_AF_MESH, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.0997024 0.627517 0.802083 0.325503], ...
    'String',mat2, ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_AF_MESH, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.13244 0.399329 0.354167 0.184564], ...
    'String',['Airfoil for rotor blade section out to r/R of ' num2str(MESH_STA)], ...
    'Style','text', ...
    'Tag','StaticText2');
H_AF_MAIN = uicontrol('Parent',H_AF_MESH, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'FontSize',12, ...
    'Position',[0.537202 0.270903 0.21131 0.314381], ...
```

```
        'String',['Select|0012|HH-02|VR-12|VR-15|SC1094R8|SC1095R8'], ...
        'Style','popupmenu', ...
        'Callback','global AF_MAIN, AF_MAIN=get(gcbo,"Value");',...
    'Tag','PopupMenu1', ...
        'Value',1);
b = uicontrol('Parent',H_AF_MESH, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'Position',[0.13244 0.0973154 0.354167 0.194631], ...
        'String',['Airfoil for rotor blade from ' num2str(MESH_STA) ' r/R out to tip.'], ...
        'Style','text', ...
        'Tag','StaticText2');
H_AF_TIP = uicontrol('Parent',H_AF_MESH, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'FontSize',12, ...
        'Position',[0.53869 -0.0234114 0.21131 0.32107], ...
        'String',['Select|0012|HH-02|VR-12|VR-15|SC1094R8|SC1095R8'], ...
    'Callback','global AF_TIP,AF_TIP=get(gcbo,"Value");',...
    'Style','popupmenu', ...
        'Tag','PopupMenu1', ...
        'Value',1);
b = uicontrol('Parent',H_AF_MESH, ...
        'Units','points', ...
        'BackgroundColor',[0.847059 0.752941 0.627451], ...
        'Position',[7.44828 6.82759 404.069 286.138], ...
        'Style','frame', ...
        'Tag','Frame1', ...
        'Visible','off');
b = uicontrol('Parent',H_AF_MESH, ...
        'Units','points', ...
        'FontSize',14, ...
        'FontWeight','bold', ...
        'Position',[332.69 56.4828 42.8276 28.5517], ...
    'String','O.K.', ...
    'Callback','performance_input_fcn ok',...
        'Tag','Pushbutton1');

assignin('base','H_AF_MAIN',H_AF_MAIN)
assignin('base','H_AF_TIP',H_AF_TIP)
```

APPENDIX Z. CREATE_PLOTS.M

This file generates the output plots for all iteration methods

```
% Create_Plots.m

% Plots of Performance Output - change figure nbrs as needed
% add/comment out figures as needed    %%%%
% JANRAD 98 VERSION 5.0

global REGIME S_PERF_INPUT MINUM RADSPC_VAL filename3 PICK OUT_COUNT PLOT_VALS

unstructure
if PICK ~=0
  load output
  load tailop
end
if REGIME==1
  load extra9
end

switch PICK
case 0
  eval(['load ',filename3])
  if RADSPC_VAL==1
    dr=[dr (R-Reff)]*12
  else
    dr=dr*12;
  end
  if get(H_NO_IT_P1,'Value')==1

    figure(11)

    subplot(2,1,1)
    plot(r./R,dT(1,:)./dr,'k'),grid
    title('Psi = 0 deg')
    xlabel('Blade Position r/R');ylabel('Airload (Lb/in)');

    subplot(2,1,2)
    plot(r./R,dT(floor(naz/4),:)./dr,'k'),grid
    title('Psi = 90 deg')
    xlabel('Blade Position r/R');ylabel('Airload (Lb/in)');
    toptitle(['Airload vs Radial Blade Stations At ',num2str(Vinf/1.68781),' Kts'])

    figure(12)

    subplot(2,1,1)
    plot(r./R,dT(floor(naz/2),:)./dr,'k'),grid
    title('Psi = 180 deg')
    xlabel('Blade Position r/R'); ylabel('Airload (Lb/in)');

    subplot(2,1,2)
    plot(r./R,dT(floor(3*naz/4),:)./dr,'k'),grid
    title('Psi = 270 deg')
```

```
  xlabel('Blade Position r/R'); ylabel('Airload (Lb/in)');
  toptitle(['Airload vs Radial Blade Stations At ',num2str(Vinf/1.68781),' Kts'])
end

if get(H_NO_IT_P2,'Value')==1
  figure(13)
  if RADSPC_VAL==1
    [th,r1] = meshgrid((-180:360/naz:180)*pi/180,r/R );
  else
    [th,r1] = meshgrid((-180:360/naz:180)*pi/180,r/R);
  end
  [x,y] = pol2cart(th,r1);
  dT1=[dT; dT(1,:)];
  for i=1:naz+1
    dT1(i,:)=dT1(i,:)./dr;
  end
  mesh(x',y',dT1)
  view(315,60)
  axis([-1 1 -1 1 -5 40])
  xlabel('Starboard'); ylabel('Aft'); zlabel('Aero Load, Lb/in');
  title(['Airload Distribution At ',num2str(Vinf/1.68781),' Kts'])
end

if get(H_NO_IT_P3,'Value')==1
  figure(14)
  n=length(PLOT_VALS);
  rows=ceil(n/2);
  for i=1:n
    k=find(r==(interp1(r,r,PLOT_VALS(i)*R,'nearest')));
    subplot(rows,2,i)
    if (floor(i/2)==(i/2))
      plot(psi,dM(:,k)),grid,axis tight
      title(['r/R = ',num2str(PLOT_VALS(i))])
      if i==n
        xlabel('Azimuth(deg)');
      end
    else plot(psi,dM(:,k)),grid,axis tight
      title(['r/R = ',num2str(PLOT_VALS(i))])
      if (i==n|i==n-1)
        xlabel('Azimuth(deg)');
      end
      ylabel('Thrust Moment(ft-lb)')
    end
  end
  toptitle(['Thrust Moment vs Azimuth At ',num2str(Vinf/1.68781),' Kts'])
end
if get(H_NO_IT_P4,'Value')==1
  figure(15)
  subplot(2,2,1)
  plot(r./R,dN(1,:)/dr,'k'),grid
  title('Psi = 0 deg')
  ylabel('Lift,Lb/in');

  subplot(2,2,2)
  plot(r./R,dN(floor(naz/4),:)/dr,'k'),grid
```

```
    title('Psi = 90 deg')

    subplot(2,2,3)
    plot(r./R,dN(floor(naz/2),:)/dr,'k'),grid
    title('Psi = 180 deg')
    xlabel('r/R'); ylabel('Lift,Lb/in');

    subplot(2,2,4)
    plot(r./R,dN(floor(3*naz/4),:)/dr,'k'),grid
    title('Psi = 270 deg')
    xlabel('r/R');
    toptitle(['Normal Force (Lift) vs Radial Blade Stations At ',num2str(Vinf/1.68781),' Kts'])
  end

case 1
  load extra1

  if get(H_AS_IT_P1,'Value')==1
    %%%% Main Rotor plots - Speed vs T/RHP/TPPangle/Liftpercent - 4 on 1 page %%%%
    figure(11)
    %subplot 221;plot(speed,LoverD); ylabel('W/De'); xlabel('Airspeed (kts)')
    subplot 221; plot(speed,thrust);grid, ylabel('Rotor Thrust (lb)')
    subplot 222; plot(speed,RHP); grid,ylabel('Rotor Horsepower')
    subplot 223; plot(speed,angle); grid,xlabel('Airspeed, Kts'); ylabel('Tip Path Plane Angle (deg)')
    subplot 224; plot(speed,Lperc); grid,xlabel('Airspeed, Kts');ylabel('Wing Lift Percentage')
    %subplot 223; plot(mu,ctonsig)

    %%%% Exact numbers for above graphs
    %disp(' Speed       W/De       RHP     TPP Angle     Lift Percent')
    %final=[speed LoverD RHP angle Lperc];
  end

  if get(H_AS_IT_P2,'Value')==1
    %%%% Total Pwr reqd vs Airspeed%%%%
    figure(12)
    if MINUM==0&PA==0&REGIME==1
      Totpwr(1)=Ptige(1);
    end
    plot(speed, Totpwr),hold,grid
    plot(speed, RHP,'r')
    plot(speed, pwrtail,'g')
    title('Power Required vs Airspeed')
    xlabel('Airspeed (kts)')
    ylabel('Shaft Horsepower')
    text(1.01*min(speed),.995*max(Totpwr),['Omega = ' num2str(omega) ' rad/sec'])
    legend('Total Power','Rotor Power','Tail HP',0)
    if MINUM==0&PA==0&REGIME==1
      text(min(speed)+10,min(Totpwr)+10,'Value at Vinf=0 is HIGE Power')
    end
  end

  %if get(H_AS_IT_P3,'Value')==1
  %  %%%% Fan-in-Tail Plots - Thrust vs Speed & Pwr vs Speed - on 1 page %%%%
  %  figure(13)
  %  subplot 211; plot(speed, Tfan,speed,Tfin,'--'),grid
```

```
% title('Anti-Torque Thrust Required and Vertical Fin Thrust Provided')
% ylabel('Thrust (lbs)');legend('Fan Thrust','Vert Fin Lift',0)
% subplot 212; plot(speed,pwrfani,'--',speed,pwrfanp,'-.',speed,pwrfant),grid
% title('Fan Power Required')
% xlabel('Airspeed (kts)');ylabel('Power (hp)')
% legend('Induced Power','Profile Power','Total Power',0)
%end
if get(H_AS_IT_P3,'Value')==1
  %%%% Rotor Speed vs Speed (Variable omega)
  figure(13)
  plot(speed,rot_spd)
  title('Rotor Speed vs Airspeed For Constant Vtip = 0.87 Mach')
  xlabel('Airspeed (kts)');ylabel('Omega (rad/sec)')
  axis([140 220 21 24.5])
end

%if get(H_AS_IT_P4,'Value')==1
% %%%% Fan-in-Tail Plot - Speed vs Tot Fan Pwr %%%%
% figure(14)
% plot(speed, pwrfant./RHP*100),grid
% title('Tail Rotor Power Required as Percent of Rotor Power')
% xlabel('Airspeed')
% ylabel('Percent Rotor Power')
%end
if get(H_AS_IT_P4,'Value')==1
  figure(14)
  plot(speed, auxthrust),grid
  title('Auxiliary Thrust Required vs Airspeed, Wing Carrying 70% Total Lift')
  xlabel('Airspeed (kts)')
  ylabel('Auxiliary Thrust (lb)')
end

if get(H_AS_IT_P5,'Value')==1
  %%%% Plot of Coeff of Pwr vs Coeff of Thrust at Max Airspeed %%%%
  figure(15)
  plot(Tcoeff,Pcoeff),grid
  title('CP versus CT for Maximum Airspeed')
  xlabel('Thrust Coefficient (CT)')
  ylabel('Engine Power Coefficient (CP)')
end

if get(H_AS_IT_P6,'Value')==1
  %%%% Plot of Coefficient of Thrust vs Figure of Merit %%%%
  figure(16)
  plot(Tcoeff,figmrt),grid
  title('HOGE FM versus CT for SLS')
  xlabel('Thrust Coefficient (CT)')
  ylabel('Figure of Merit (FM)')
end
if get(H_AS_IT_P7,'Value')==1
  %%%% Rotor Drag vs Airspeed %%%%
  figure(17)
  plot(speed,Rotdrag,'r'),hold on,grid
  plot(speed,Wingdrag,'b')
  plot(speed,Drag,'g')
```

```
    title('Drag vs Airspeed')
    xlabel('Airspeed (Kts)')
    ylabel('Drag (lbs)')
    legend('Rotor Drag','Wing Drag','Total Drag',0)
  end
  if get(H_AS_IT_P8,'Value')==1
    %%%% Required Collective Pitch vs Airspeed %%%%
    figure(18)
    plot(speed,coll_pit),grid
    title('Required Collective Pitch vs Airspeed')
    xlabel('Airspeed (Kts)')
    ylabel('Collective Pitch (degrees)')
  end
  if get(H_AS_IT_P9,'Value')==1
   %%%% Total Pwr reqd vs Airspeed%%%%
    figure(11)
    plot(speed, Totpwr),hold,grid
    plot(speed, RHP,'r')
    plot(speed, pwrtail,'g')
    title('Power Required vs Airspeed')
    xlabel('Airspeed (Kts)')
    ylabel('Shaft Horsepower')
    legend('Total Power','Rotor Power','Tail HP',0)
    gtext('Omega= 20 rad/s Above 140 kts')
  end
  if get(H_AS_IT_P10,'Value')==1
    %%%% b1s vs Airspeed %%%%
    figure(20)
    plot(speed,long_coeff),grid
    title('1st Longitudinal Cyclic Term vs Airspeed')
    xlabel('Airspeed (Kts)')
    ylabel('b1s')
  end

case 2
  load extra2
  if get(H_AL_IT_P1,'Value')==1
    %%%% Total Pwr reqd vs Altitude%%%%
    figure(11)

    if MINUM==0&Vinf==0&REGIME==1
      Totpwr(1)=Ptige(1);
    end

    plot(altitude, Totpwr),grid
    title('Total Power Required vs Altitude')
    xlabel('Pressure Altitude (ft)')
    ylabel('Shaft Horsepower')
    if MINUM==0&Vinf==0&REGIME==1
      text(min(altitude)+50,min(Totpwr)+10,'Value at PA=0 is HIGE Power')
    end
  end
  if get(H_AL_IT_P2,'Value')==1
    %%%% Rotor Drag vs Altitude %%%%
    figure(12)
```

```
    altitude
    Rotdrag
    plot(altitude,Rotdrag),grid
    title('Rotor Drag vs Altitude')
    xlabel('Pressure Altitude (ft)')
    ylabel('Rotor Drag (lbs)')
  end
  if get(H_AL_IT_P3,'Value')==1
    %%%% Required Collective Pitch vs Altitude %%%%
    figure(13)
    plot(altitude,coll_pit),grid
    title('Required Collective Pitch vs Altitude')
    xlabel('Pressure Altitude (ft)')
    ylabel('Collective Pitch (degrees)')
  end
  if get(H_AL_IT_P4,'Value')==1
    %%%% a1s vs Altitude %%%%
    figure(14)
    plot(altitude,lat_coeff),grid
    title('1st Lateral Cyclic Term vs Altitude')
    xlabel('Pressure Altitude (ft)')
    ylabel('a1s')
  end
  if get(H_AL_IT_P5,'Value')==1
    %%%% b1s vs Altitude %%%%
    figure(15)
    plot(altitude,long_coeff),grid
    title('1st Longitudinal Cyclic Term vs Altitude')
    xlabel('Pressure Altitude (ft)')
    ylabel('b1s')
  end

case 3
  load extra3
   if get(H_GW_IT_P1,'Value')==1
    %%%% Total Pwr reqd vs Gross Weight%%%%
    figure(11)
    plot(wt, Totpwr),grid
    title('Total Power Required vs Gross Weight')
    xlabel('Gross Weight (lb)')
    ylabel('Shaft Horsepower')
  end
  if get(H_GW_IT_P2,'Value')==1
    %%%% Rotor Drag vs Gross Weight %%%%
    figure(12)
    plot(wt,Rotdrag),grid
    title('Rotor Drag vs Gross Weight')
    xlabel('Gross Weight (lb)')
    ylabel('Rotor Drag (lbs)')
  end
  if get(H_GW_IT_P3,'Value')==1
    %%%% Required Collective Pitch vs Gross Weight %%%%
    figure(13)
    plot(wt,coll_pit),grid
    title('Required Collective Pitch vs Gross Weight')
```

```
    xlabel('Gross Weight (lb)')
    ylabel('Collective Pitch (degrees)')
  end
  if get(H_GW_IT_P4,'Value')==1
    %%%% a1s vs Gross Weight %%%%
    figure(14)
    plot(wt,lat_coeff),grid
    title('1st Lateral Cyclic Term vs Gross Weight')
    xlabel('Gross Weight (lb)')
    ylabel('a1s')
  end
  if get(H_GW_IT_P5,'Value')==1
    %%%% b1s vs Gross Weight %%%%
    figure(15)
    plot(wt,long_coeff),grid
    title('1st Longitudinal Cyclic Term vs Gross Weight')
    xlabel('Gross Weight (lb)')
    ylabel('b1s')
  end
  if get(H_GW_IT_P6,'Value')==1
    %%%% Plot of Coefficient of Thrust vs Gross Weight %%%%
    figure(16)
    plot(wt,Tcoeff),grid
    title('Coefficient of Thrust vs Gross Weight')
    xlabel('Gross Weight (lb)')
    ylabel('Thrust Coefficient (CT)')
  end
  if get(H_GW_IT_P7,'Value')==1
    %%%% Plot of Coefficient of Power vs Gross Weight %%%%
    figure(17)
    plot(wt,Pcoeff),grid
    title('Coefficient of Power vs Gross Weight')
    xlabel('Gross Weight (lb)')
    ylabel('Power Coefficient (CP)')
  end
  if get(H_GW_IT_P8,'Value')==1
    %%%% Plot of Figure of Merit vs Gross Weight %%%%
    figure(18)
    plot(wt,figmrt),grid
    title('Figure of Merit vs Gross Weight')
    xlabel('Gross Weight (lb)')
    ylabel('Figure of Merit')
  end
  if get(H_GW_IT_P9,'Value')==1&REGIME==1&PA==0

    figure(19)
    plot(wt,Ptige),grid
    title('HIGE Power Required vs Gross Weight')
    xlabel('Gross Weight (lb)')
    ylabel('Shaft Horsepower')
  end


case 4
   load extra4
```

```
if get(H_BT_IT_P1,'Value')==1
  %%%% Total Pwr reqd vs Blade Twist%%%%
  figure(11)
  plot(thetat, Totpwr),grid
  title('Total Power Required vs Blade Twist')
  xlabel('Blade Twist (deg)')
  ylabel('Shaft Horsepower')
end
if get(H_BT_IT_P2,'Value')==1
  %%%% Rotor Drag vs Blade Twist (deg) %%%%
  figure(12)
  plot(thetat,Rotdrag),grid
  title('Rotor Drag vs Blade Twist')
  xlabel('Blade Twist (deg)')
  ylabel('Rotor Drag (lbs)')
end
if get(H_BT_IT_P3,'Value')==1
  %%%% Required Collective Pitch vs Blade Twist (deg) %%%%
  figure(13)
  plot(thetat,coll_pit),grid
  title('Required Collective Pitch vs Blade Twist')
  xlabel('Blade Twist (deg)')
  ylabel('Collective Pitch (degrees)')
end
if get(H_BT_IT_P4,'Value')==1
  %%%% a1s vs Blade Twist (deg) %%%%
  figure(14)
  plot(thetat,lat_coeff),grid
  title('1st Lateral Cyclic Term vs Blade Twist')
  xlabel('Blade Twist (deg)')
  ylabel('a1s')
end
if get(H_BT_IT_P5,'Value')==1
  %%%% b1s vs Blade Twist (deg) %%%%
  figure(15)
  plot(thetat,long_coeff),grid
  title('1st Longitudinal Cyclic Term vs Blade Twist')
  xlabel('Blade Twist (deg)')
  ylabel('b1s')
end
if get(H_BT_IT_P6,'Value')==1
  %%%% Plot of Coefficient of Thrust vs Blade Twist (deg) %%%%
  figure(16)
  plot(thetat,Tcoeff),grid
  title('Coefficient of Thrust vs Blade Twist')
  xlabel('Blade Twist (deg)')
  ylabel('Thrust Coefficient (CT)')
end
if get(H_BT_IT_P7,'Value')==1
  %%%% Plot of Coefficient of Power vs Blade Twist (deg) %%%%
  figure(17)
  plot(thetat,Pcoeff),grid
  title('Coefficient of Power vs Blade Twist')
  xlabel('Blade Twist (deg)')
  ylabel('Power Coefficient (CP)')
```

```
 end
 if get(H_BT_IT_P8,'Value')==1
   %%%% Plot of Figure of Merit vs Blade Twist (deg) %%%%
   figure(16)
   plot(thetat,figmrt),grid
   title('Figure of Merit vs Blade Twist')
   xlabel('Blade Twist (deg)')
   ylabel('Figure of Merit')
 end

case 5
   load extra5
   if get(H_BTR_IT_P1,'Value')==1
   %%%% Total Pwr reqd vs Blade Taper Ratio%%%%
   figure(11)
   plot(taper, Totpwr),grid
   title('Total Power Required vs Blade Taper Ratio')
   xlabel('Blade Taper Ratio')
   ylabel('Shaft Horsepower')
 end
 if get(H_BTR_IT_P2,'Value')==1
   %%%% Rotor Drag vs Blade Taper Ratio%%%%
   figure(12)
   plot(taper,Rotdrag),grid
   title('Rotor Drag vs Blade Taper Ratio')
   xlabel('Blade Taper Ratio')
   ylabel('Rotor Drag (lbs)')
 end
 if get(H_BTR_IT_P3,'Value')==1
   %%%% Required Collective Pitch vs Blade Taper Ratio%%%%
   figure(13)
   plot(taper,coll_pit),grid
   title('Required Collective Pitch vs Blade Taper Ratio')
   xlabel('Blade Taper Ratio')
   ylabel('Collective Pitch (degrees)')
 end
 if get(H_BTR_IT_P4,'Value')==1
   %%%% a1s vs Blade Taper Ratio %%%%
   figure(14)
   plot(taper,lat_coeff),grid
   title('1st Lateral Cyclic Term vs Blade Taper Ratio')
   xlabel('Blade Taper Ratio')
   ylabel('a1s')
 end
 if get(H_BTR_IT_P5,'Value')==1
   %%%% b1s vs Blade Taper Ratio %%%%
   figure(15)
   plot(taper,long_coeff),grid
   title('1st Longitudinal Cyclic Term vs Blade Taper Ratio')
   xlabel('Blade Taper Ratio')
   ylabel('b1s')
 end
 if get(H_BTR_IT_P6,'Value')==1
   %%%% Plot of Coefficient of Thrust vs Blade Taper Ratio %%%%
   figure(16)
```

```
    plot(taper,Tcoeff),grid
    title('Coefficient of Thrust vs Blade Taper Ratio')
    xlabel('Blade Taper Ratio')
    ylabel('Thrust Coefficient (CT)')
  end
  if get(H_BTR_IT_P7,'Value')==1
    %%%% Plot of Coefficient of Power vs Blade Taper Ratio %%%%
    figure(17)
    plot(taper,Pcoeff),grid
    title('Coefficient of Power vs Blade Taper Ratio')
    xlabel('Blade Taper Ratio')
    ylabel('Power Coefficient (CP)')
  end
  if get(H_BTR_IT_P8,'Value')==1
    %%%% Plot of Figure of Merit vs Blade Taper Ratio %%%%
    figure(16)
    plot(taper,figmrt),grid
    title('Figure of Merit vs Blade Taper Ratio')
    xlabel('Blade Taper Ratio')
    ylabel('Figure of Merit')
  end

case 6
   load extra6
    if get(H_SOT_IT_P1,'Value')==1
    %%%% Total Pwr reqd vs Start of Taper Position%%%%
    figure(11)
    plot(start, Totpwr),grid
    title('Total Power Required vs Start of Taper Position')
    xlabel('Start of Taper Position')
    ylabel('Shaft Horsepower')
  end
  if get(H_SOT_IT_P2,'Value')==1
    %%%% Rotor Drag vs Start of Taper Position%%%%
    figure(12)
    plot(start,Rotdrag),grid
    title('Rotor Drag vs Start of Taper Position')
    xlabel('Start of Taper Position')
    ylabel('Rotor Drag (lbs)')
  end
  if get(H_SOT_IT_P3,'Value')==1
    %%%% Required Collective Pitch vs Start of Taper Position%%%%
    figure(13)
    plot(start,coll_pit),grid
    title('Required Collective Pitch vs Start of Taper Position')
    xlabel('Start of Taper Position')
    ylabel('Collective Pitch (degrees)')
  end
  if get(H_SOT_IT_P4,'Value')==1
    %%%% a1s vs Start of Taper Position %%%%
    figure(14)
    plot(start,lat_coeff),grid
    title('1st Lateral Cyclic Term vs Start of Taper Position')
    xlabel('Start of Taper Position')
    ylabel('a1s')
```

```
  end
  if get(H_SOT_IT_P5,'Value')==1
    %%%% b1s vs Start of Taper Position %%%%
    figure(15)
    plot(start,long_coeff),grid
    title('1st Longitudinal Cyclic Term vs Start of Taper Position')
    xlabel('Start of Taper Position')
    ylabel('b1s')
  end
  if get(H_SOT_IT_P6,'Value')==1
    %%%% Plot of Coefficient of Thrust vs Start of Taper Position %%%%
    figure(16)
    plot(start,Tcoeff),grid
    title('Coefficient of Thrust vs Start of Taper Position')
    xlabel('Start of Taper Position')
    ylabel('Thrust Coefficient (CT)')
  end
  if get(H_SOT_IT_P7,'Value')==1
    %%%% Plot of Coefficient of Power vs Start of Taper Position %%%%
    figure(17)
    plot(start,Pcoeff),grid
    title('Coefficient of Power vs Start of Taper Position')
    xlabel('Start of Taper Position')
    ylabel('Power Coefficient (CP)')
  end
  if get(H_SOT_IT_P8,'Value')==1
    %%%% Plot of Figure of Merit vs Start of Taper Position %%%%
    figure(16)
    plot(start,figmrt),grid
    title('Figure of Merit vs Start of Taper Position')
    xlabel('Start of Taper Position')
    ylabel('Figure of Merit')
  end

case 7
  load extra7
   if get(H_WSA_IT_P1,'Value')==1
    %%%% Total Pwr reqd vs Wing Span Area%%%%
    figure(11)
    plot(area, Totpwr),hold,grid
    plot(area, RHP,'r')
    plot(area, pwrtail,'g')
    title('Power Required vs Wing Span Area')
    xlabel('Wing Span Area (ft^2)')
    ylabel('Shaft Horsepower')
    legend('Total Power','Rotor Power','Tail HP',0)
  end
  if get(H_WSA_IT_P2,'Value')==1
    %%%% Aux Thrust and Drag vs Wing Span Area%%%%
    figure(12)
    plot(area,Wingdrag),hold,grid
    plot(area,Rotdrag,'--')
    plot(area,auxthrust,'r')
    title('Aux Thrust and Drag vs Wing Span Area')
    xlabel('Wing Span Area (ft^2)')
```

```
  ylabel('Drag (lbs)')
  legend('Wing Drag','Rotor Drag','Aux Thrust',0)
end
if get(H_WSA_IT_P3,'Value')==1
  %%%% Required Collective Pitch vs Wing Span Area%%%%
  figure(13)
  plot(area,coll_pit),grid
  title('Required Collective Pitch vs Wing Span Area')
  xlabel('Wing Span Area (ft^2)')
  ylabel('Collective Pitch (degrees)')
end
if get(H_WSA_IT_P4,'Value')==1
  %%%% Wing Lift vs Wing Span Area %%%%
  figure(14)
  plot(area,Winglift),grid
  title('Wing Lift vs Wing Span Area')
  xlabel('Wing Span Area (ft^2)')
  ylabel('Lift (lb)')
end
if get(H_WSA_IT_P5,'Value')==1
  %%%% Tail Rotor Power Required vs Wing Span Area %%%%
  figure(15)
  plot(area,pwrtail),grid
  title('Tail Rotor Power Required vs Wing Span Area')
  xlabel('Wing Span Area (ft^2)')
  ylabel('Tail Rotor Power (HP)')
end
if get(H_WSA_IT_P6,'Value')==1
  %%%% Plot of Coefficient of Thrust vs Wing Span Area %%%%
  figure(16)
  plot(area,Tcoeff),grid
  title('Coefficient of Thrust vs Wing Span Area')
  xlabel('Wing Span Area (ft^2)')
  ylabel('Thrust Coefficient (CT)')
end
if get(H_WSA_IT_P7,'Value')==1
  %%%% Plot of Coefficient of Power vs Wing Span Area %%%%
  figure(17)
  plot(area,Pcoeff),grid
  title('Coefficient of Power vs Wing Span Area')
  xlabel('Wing Span Area (ft^2)')
  ylabel('Power Coefficient (CP)')
end
if get(H_WSA_IT_P8,'Value')==1
  %%%% Plot of Figure of Merit vs Wing Span Area %%%%
  figure(18)
  plot(area,figmrt),grid
  title('Figure of Merit vs Wing Span Area')
  xlabel('Wing Span Area (ft^2)')
  ylabel('Figure of Merit')
end
if get(H_WSA_IT_P9,'Value')==1
  %%%% Plot of Disk Loading vs Wing Span Area %%%%
  figure(19)
  plot(area,diskload),grid
```

```
    title('Disk Loading vs Wing Span Area')
    xlabel('Wing Span Area (ft^2)')
    ylabel('Disk Loading')
  end
  if get(H_WSA_IT_P10,'Value')==1
    %%%% Plot of Wing Lift As % of Total Lift vs Wing Span Area %%%%
    figure(20)
    plot(area,Lperc),grid
    title('Percent of Total Lift On Wing vs Wing Span Area')
    xlabel('Wing Span Area (ft^2)')
    ylabel('Percent of Total Lift')
  end
case 8
  load extra8
  if get(H_RBR_IT_P1,'Value')==1
    %%%% Total Pwr reqd vs Main Rotor Radius%%%%
    figure(11)
    plot(mrb_radius, Totpwr),hold,grid
    plot(mrb_radius, RHP,'r')
    plot(mrb_radius, pwrtail,'g')
    title(['Power Required vs Main Rotor Radius at ', num2str(fix(Vinf/1.68781)),' Kts'])
    xlabel('Main Rotor Radius (ft)')
    ylabel('Shaft Horsepower')
    text(1.01*min(mrb_radius),.995*max(Totpwr),['Omega = ' num2str(omega) ' rad/sec'])
    legend('Total Power','Rotor Power','Tail HP',0)
  end
  if get(H_RBR_IT_P2,'Value')==1
    %%%% Aux Thrust and Drag vs Main Rotor Radius%%%%
    figure(12)
    plot(mrb_radius,Wingdrag),hold,grid
    plot(mrb_radius,Rotdrag,'--')
    plot(mrb_radius,auxthrust,'r')
    title('Aux Thrust and Drag vs Main Rotor Radius')
    xlabel('Main Rotor Radius (ft)')
    ylabel('Drag (lbs)')
    legend('Wing Drag','Rotor Drag','Aux Thrust',0)
  end
  if get(H_RBR_IT_P3,'Value')==1
    %%%% Required Collective Pitch vs Main Rotor Radius%%%%
    figure(13)
    plot(mrb_radius,coll_pit),grid
    title('Required Collective Pitch vs Main Rotor Radius')
    xlabel('Main Rotor Radius (ft)')
    ylabel('Collective Pitch (degrees)')
  end
  if get(H_RBR_IT_P4,'Value')==1
    %%%% Tail Rotor Power Required vs Main Rotor Radius %%%%
    figure(14)
    plot(mrb_radius,pwrtail),grid
    title('Tail Rotor Power Required vs Main Rotor Radius')
    xlabel('Main Rotor Radius (ft)')
    ylabel('Tail Rotor Power (HP)')
  end
  if get(H_RBR_IT_P5,'Value')==1
    %%%% Plot of Figure of Merit vs Main Rotor Radius %%%%
```

```
    figure(15)
    plot(mrb_radius,figmrt),grid
    title('Figure of Merit vs Main Rotor Radius')
    xlabel('Main Rotor Radius (ft)')
    ylabel('Figure of Merit')
  end
  if get(H_RBR_IT_P6,'Value')==1
    %%%% Plot of Disk Loading vs Main Rotor Radius %%%%
    figure(16)
    plot(mrb_radius,diskload),grid
    title('Disk Loading vs Main Rotor Radius')
    xlabel('Main Rotor Radius (ft)')
    ylabel('Disk Loading')

  end
case 9
  load extra9
  if get(H_RBS_IT_P1,'Value')==1
    %%%% Total Pwr reqd vs Main Rotor Speed%%%%
    figure(11)
    plot(rot_spd, Totpwr),hold,grid
    plot(rot_spd, RHP,'r')
    plot(rot_spd, pwrtail,'g')
    title(['Power Required vs Main Rotor Speed at ', num2str(fix(Vinf/1.68781)),' Kts'])
    xlabel('Main Rotor Speed (rad/sec)')
    ylabel('Shaft Horsepower')
    text(1.01*min(rot_spd),.995*max(Totpwr),['Radius = ' num2str(R) ' ft'])
    legend('Total Power','Rotor Power','Tail HP',0)
  end
  if get(H_RBS_IT_P2,'Value')==1
    %%%% Aux Thrust and Drag vs Main Rotor Speed%%%%
    figure(12)
    plot(rot_spd,Wingdrag),hold,grid
    plot(rot_spd,Rotdrag,'--')
    plot(rot_spd,auxthrust,'r')
    title('Aux Thrust and Drag vs Main Rotor Speed')
    xlabel('Main Rotor Speed (rad/sec)')
    ylabel('Drag (lbs)')
    legend('Wing Drag','Rotor Drag','Aux Thrust',0)
  end
  if get(H_RBS_IT_P3,'Value')==1
    %%%% Required Collective Pitch vs Main Rotor Speed%%%%
    figure(13)
    plot(rot_spd,coll_pit),grid
    title('Required Collective Pitch vs Main Rotor Speed')
    xlabel('Main Rotor Speed (rad/sec)')
    ylabel('Collective Pitch (degrees)')
  end
  if get(H_RBS_IT_P4,'Value')==1
    %%%% Tail Rotor Power Required vs Main Rotor Speed %%%%
    figure(14)
    plot(rot_spd,pwrtail),grid
    title('Tail Rotor Power Required vs Main Rotor Speed')
    xlabel('Main Rotor Speed (rad/sec)')
    ylabel('Tail Rotor Power (HP)')
```

```
  end
  if get(H_RBS_IT_P5,'Value')==1
    %%%% Plot of Disk Loading vs Main Rotor Speed %%%%
    figure(15)
    plot(rot_spd,diskload),grid
    title('Disk Loading vs Main Rotor Speed')
    xlabel('Main Rotor Speed (rad/sec)')
    ylabel('Disk Loading')
  end
end
OUT_COUNT=1;
options
```

APPENDIX AA. CREATE_PLOTS_FCN.M

Switchyard callback function for create_plots.m

```
function create_plots_fcn(Action)

% Switchyard Callback function for create_plots.m
% JANRAD 98 VERSION 5.0

global PICK REGIME H_NO_IT S_MATR_VEC H_NO_IT_P1 H_NO_IT_P2 H_NO_IT_P3
H_NO_IT_P4 filename3...
  H_AS_IT H_AS_IT_P1 H_AS_IT_P2 H_AS_IT_P3 H_AS_IT_P4 H_AS_IT_P5 H_AS_IT_P6...
  H_AS_IT_P7 H_AS_IT_P8 H_AS_IT_P9 H_AS_IT_P10 H_AL_IT H_AL_IT_P1 H_AL_IT_P2...
  H_AL_IT_P3 H_AL_IT_P4 H_AL_IT_P5 H_GW_IT H_GW_IT_P1 H_GW_IT_P2 H_GW_IT_P3...
  H_GW_IT_P4 H_GW_IT_P5 H_GW_IT_P6 H_GW_IT_P7 H_GW_IT_P8 H_GW_IT_P9 H_BT_IT
H_BT_IT_P1...
  H_BT_IT_P2 H_BT_IT_P3 H_BT_IT_P4 H_BT_IT_P5 H_BT_IT_P6 H_BT_IT_P7 H_BT_IT_P8...
  H_BTR_IT H_BTR_IT_P1 H_BTR_IT_P2 H_BTR_IT_P3 H_BTR_IT_P4 H_BTR_IT_P5...
  H_BTR_IT_P6 H_BTR_IT_P7 H_BTR_IT_P8 H_SOT_IT H_SOT_IT_P1 H_SOT_IT_P2
H_SOT_IT_P3...
  H_SOT_IT_P4 H_SOT_IT_P5 H_SOT_IT_P6 H_SOT_IT_P7 H_SOT_IT_P8...
  H_WSA_IT H_WSA_IT_P1 H_WSA_IT_P2 H_WSA_IT_P3 H_WSA_IT_P4 H_WSA_IT_P5...
  H_WSA_IT_P6 H_WSA_IT_P7 H_WSA_IT_P8 H_WSA_IT_P9 H_WSA_IT_P10 H_RBR_IT
H_RBR_IT_P1 H_RBR_IT_P2...
  H_RBR_IT_P3 H_RBR_IT_P4 H_RBR_IT_P5 H_RBR_IT_P6 H_RBS_IT H_RBS_IT_P1
H_RBS_IT_P2 H_RBS_IT_P3...
  H_RBS_IT_P4 H_RBS_IT_P5

if nargin
  switch Action
  case 'plots'
    if PICK==0
      create_plots
      close (H_NO_IT)
    end
    if PICK==1
      create_plots
      close (H_AS_IT)
    end
    if PICK==2
      create_plots
      close (H_AL_IT)
    end
    if PICK==3
      create_plots
      close (H_GW_IT)
    end
    if PICK==4
      create_plots
      close (H_BT_IT)
    end
    if PICK==5
      create_plots
      close (H_BTR_IT)
```

```
    end
    if PICK==6
      create_plots
      close (H_SOT_IT)
    end
    if PICK==7
      create_plots
      close (H_WSA_IT)
    end
    if PICK==8
      create_plots
      close (H_RBR_IT)
    end
    if PICK==9
      create_plots
      close (H_RBS_IT)
    end
  case 'back'
    options
    close (H_NO_IT)
  end
end
```

APPENDIX AB. STABILITY_AND_CONTROL.M

This file creates figure window indicating the stability and control functions have not been incorporated.

```
function stability_and_control()

% JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load stability_and_control

a = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'MenuBar','none', ...
    'Name','Stability and Control Not Installed', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.190625 0.383333 0.446875 0.34375], ...
    'Tag','Fig1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','close(gcf)', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.388112 0.109091 0.202797 0.181818], ...
    'String','OK', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.0839161 0.515152 0.811189 0.345455], ...
    'String','The Stability and Control Function is not yet Avalilable in JANRAD98', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
```

```
    'FontWeight','bold', ...
    'Position',[0.332168 0.357576 0.318182 0.127273], ...
    'String','SORRY!', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.013986 0.0363636 0.972028 0.933333], ...
    'Style','frame', ...
    'Tag','Frame1');
```

APPENDIX AC. ROTOR_DYNAMICS.M

This file creates figure window indicating the rotor dynamics functions have not been incorporated.

```
function rotor_dynamics()

% JANRAD version 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load rotor_dynamics

a = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'MenuBar','none', ...
    'Name','Rotor Dynamics Not Installed', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.190625 0.3875 0.45625 0.339583], ...
    'Tag','Fig1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','close(gcf)', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.389078 0.153374 0.204778 0.184049], ...
    'String','OK', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.0821918 0.595092 0.849315 0.319018], ...
    'String','The Rotor Dynamics Function is not yet Avalilable in JANRAD98', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
```

```
    'FontWeight','bold', ...
    'Position',[0.334471 0.429448 0.317406 0.122699], ...
    'String','SORRY!', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0205479 0.0306748 0.962329 0.93865], ...
    'Style','frame', ...
    'Tag','Frame1');
```

APPENDIX AD. TRIM_WARNING.M

This file creates GUI to inform user that the performance routine did not calculate a valid solution.

```
function trim_warning()

%   GUI window to notify user that conditions will not trim.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load trim_warning

a = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'MenuBar','none', ...
    'Name','WARNING!', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.184375 0.352083 0.5375 0.404167], ...
    'Tag','Fig1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'Position',[0.0755814 0.551546 0.825581 0.103093], ...
    'String','This configuration will not trim !', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','trim_warning_fcn', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.373547 0.0927835 0.229651 0.164948], ...
    'String','OK', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0755814 0.340206 0.825581 0.170103], ...
```

```
        'String',mat2, ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.0755814 0.695876 0.825581 0.164948], ...
        'String','Performance Analysis Routine Terminated!', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0348837 0.0463918 0.924419 0.886598], ...
        'Style','frame', ...
        'Tag','Frame1');
```

APPENDIX AE. TRIM_WARNING_FCN.M

Switchyard Callback for trim_warning.m GUI function.

```
function trim_warning_fcn()

% Switchyard Callback function for trim_warning.m
% JANRAD 98 VERSION 5.0

global H_GO H_RUPT H_BK H_RES H_MEN

set(H_GO,'Enable','off');
set(H_RUPT,'Enable','off');
set(H_BK,'Enable','on');
set(H_RES,'Enable','off');
set(H_MEN,'Enable','on');
close(gcf)
```

APPENDIX AF. EMPTY_BOXES.M

This file creates GUI to inform user that all input edit boxes must contain a entry to properly execute performance evaluation.

```
function empty_boxes()

%   GUI window called if Empty edit boxes exist when continue button is pressed.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load empty_boxes

a = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'MenuBar','none', ...
    'Name','ERROR', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.204688 0.35 0.451563 0.2875], ...
    'Tag','Fig1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','close (gcf)', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.401384 0.0942029 0.207612 0.202899], ...
    'String','OK', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',16, ...
    'FontWeight','bold', ...
    'Position',[0.107266 0.652174 0.795848 0.217391], ...
    'String','ERROR !', ...
    'Style','text', ...
    'Tag','StaticText1');
```

```
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.107266 0.333333 0.795848 0.311594], ...
    'String','All edit boxes must contain a value to create a new file.', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0380623 0.0507246 0.930796 0.905797], ...
    'Style','frame', ...
    'Tag','Frame1');
```

APPENDIX AG. STRUCTURE.M

This script M-file creates the input structure S_USER_INPUT.

```
% structure.m

% Structure Construction for JANRAD98 Performance_input.m
% JANRAD 98 VERSION 5.0

S_USER_INPUT=struct(...
  'PA',PA,...
  'temp',temp,...
  'Vinf',Vinf,...
  'GW',GW,...
  'omega',omega,...
    'naz',naz,...
  'thetao',thetao,...
  'Swing',Swing,...
  'bwing',bwing,...
  'CLwing',CLwing,...
    'CDowing',CDowing,...
    'ewing',ewing,...
  'afoil',afoil,...
  'a',a,...
  'b',b,...
  'R',R,...
    'e',e,...
    'grip',grip,...
  'rchord',rchord,...
  'tr',tr,...
  'trst',trst,...
  'twist',twist,...
  'wblade',wblade,...
    'nbe',nbe,...
    'Taux',Taux,...
  'Afh',Afh,...
  'Afv',Afv,...
  'Svert',Svert,...
  'bvert',bvert,...
    'CLvert',CLvert,...
    'CDovert',CDovert,...
  'Shoriz',Shoriz,...
  'bhoriz',bhoriz,...
  'CLhoriz',CLhoriz,...
  'CDohoriz',CDohoriz,...
  'tailrot',tailrot,...
  'taildisk',taildisk,...
  'CON_R',CON_R,...
  'CON_chord',CON_chord,...
```

```
'CON_b',CON_b,...
'CON_omega',CON_omega,...
'CON_cd',CON_cd,...
'CON_lt',CON_lt);
```

APPENDIX AH. STRUCTURE1.M

This script M-file creates the output structure S_PERF_OUTPUT.

```
% structure1.m

% Structure Consruction for JANRAD98 Performance_output.m
% JANRAD 98 VERSION 5.0

S_PERF_OUTPUT=struct(...
  'Dfuse',Dfuse,...               %Fuselage drag
  'Hrotor',Hrotor,...             %Rotor drag
  'Lwing',Lwing,...                   %Wing lift
  'Dwing',Dwing,...                   %Wing drag
  'Lhoriz',Lhoriz,...             %Horizontal tail lifT
  'Dhoriz',Dhoriz,...             %Horizontal tail drag
  'Lvert',Lvert,...               %Vertical tail side force
  'Dvert',Dvert,...               %Vertical tail drag
  'alphaT',alphaT*57.3,...  %Tip path angle
  'betao',betao*57.3,...    %Rotor coning angle
  'rT2',rT2,...                   %Location of mean thrust
  'thetao',thetao*57.3,...  %Rotor Collective pitch at .7 r/R
  'theta1c',theta1c*57.3,... %1st lat cyclic term-A1 (deg)
  'theta1s',theta1s*57.3,... %1st long cyclic term-B1 (deg)
  'solidity',solidity,...   %solidity (sigma)
  'DL',DL,...                         %Disk loading
  'FM',FM,...                         %Figure of Merit
  'CT_sig',CT_sig,...             %CT/sigma
  'CQ_sig',CQ_sig,...             %CQ/sigma
  'CH_sig',CH_sig,...             %CH/sigma
  'Machtip',Machtip,...           %Tip mach of the adv. blade
  'mu',mu,...                         %Advance ratio
  'T',T,...                       %Rotor thrust required (TPP)
  'Protor',Protor,...             %Rotor power required
  'Qrotor',Qrotor);                   %Rotor torque
```

APPENDIX AI. STRUCTURE2.M

This script M-file creates the vector structure S_MATR_VEC.

```
% structure2.m

% Structure Consnruction for JANRAD98 Performance_output.m
% JANRAD 98 VERSION 5.0

S_MATR_VEC=struct(...
  'r',r,...            %radial distance
  'dr',dr,...           %differential radial distance
  'psi',psi,...         %azimuth
  'vi',vi,...           %induced velocity
  'theta',theta,...     %collective pitch
  'betat',betat,...     %coning angle
  'alpha',alpha,...     %angle of attack
  'Tpsi',Tpsi,...       %Thrust at azimuth position
  'Npsi',Npsi,...       %Normal Force (lift) at azimuth position
  'Mpsi',Mpsi,...       %Thrust Moment at azimuth position
  'DMpsi',DMpsi,...     %Drag Moment at azimuth position
  'dT',dT,...           %incremental Thrust
  'dN',dN,...           %incremental Normal Force (lift)
  'dM',dM,...           %incremental Thrust moment
  'dD',dD,...           %incremental drag
  'cblade',cblade,...   %blade chord
  'CL',CL,...           %incremental CL values
  'CD',CD,...           %incremental CD values
  'Reff',Reff);         %Effective Blade Radius
```

APPENDIX AJ. UNSTRUCTURE.M

This script M-file decomposes the S_PERF_INPUT structure into 36 separate input parameter variables. These variables are corrected to proper units used in Perf.m computations.

```
% unstructure.m

% Structure De-Consruction for JANRAD98 Perf.m
% JANRAD 98 VERSION 5.0

 PA=S_PERF_INPUT.PA;
 temp=S_PERF_INPUT.temp;
 Vinf=S_PERF_INPUT.Vinf;
 GW=S_PERF_INPUT.GW;
 omega=S_PERF_INPUT.omega;
   naz=S_PERF_INPUT.naz;
 thetao=S_PERF_INPUT.thetao;
 Swing=S_PERF_INPUT.Swing;
 bwing=S_PERF_INPUT.bwing;
 CLwing=S_PERF_INPUT.CLwing;
   CDowing=S_PERF_INPUT.CDowing;
   ewing=S_PERF_INPUT.ewing;
 afoil=S_PERF_INPUT.afoil;
   a=S_PERF_INPUT.a;
 b=S_PERF_INPUT.b;
 R=S_PERF_INPUT.R;
   e=S_PERF_INPUT.e;
   grip=S_PERF_INPUT.grip;
 rchord=S_PERF_INPUT.rchord;
 tr=S_PERF_INPUT.tr;
 trst=S_PERF_INPUT.trst;
 twist=S_PERF_INPUT.twist;
 wblade=S_PERF_INPUT.wblade;
   nbe=S_PERF_INPUT.nbe;
   Taux=S_PERF_INPUT.Taux;
 Afh=S_PERF_INPUT.Afh;
 Afv=S_PERF_INPUT.Afv;
 Svert=S_PERF_INPUT.Svert;
 bvert=S_PERF_INPUT.bvert;
   CLvert=S_PERF_INPUT.CLvert;
   CDovert=S_PERF_INPUT.CDovert;
 Shoriz=S_PERF_INPUT.Shoriz;
 bhoriz=S_PERF_INPUT.bhoriz;
 CLhoriz=S_PERF_INPUT.CLhoriz;
 CDohoriz=S_PERF_INPUT.CDohoriz;
 tailrot=S_PERF_INPUT.tailrot;
 taildisk=S_PERF_INPUT.taildisk;
```

```
CON_R=S_PERF_INPUT.CON_R;
CON_chord=S_PERF_INPUT.CON_chord;
CON_b=S_PERF_INPUT.CON_b;
CON_omega=S_PERF_INPUT.CON_omega;
CON_cd=S_PERF_INPUT.CON_cd;
CON_lt=S_PERF_INPUT.CON_lt;
```

APPENDIX AK. UNSTRUCTURE1.M

This script M-file decomposes the S_USER_INPUT structure into 36 separate input parameter variables. These variables are the actual values the user types or loads from a previously saved file

```
% unstructure1.m

% Structure De-Consruction for JANRAD98 Performance_input.m
% JANRAD 98 VERSION 5.0

  PA=S_USER_INPUT.PA;
  temp=S_USER_INPUT.temp;
  Vinf=S_USER_INPUT.Vinf;
  GW=S_USER_INPUT.GW;
  omega=S_USER_INPUT.omega;
    naz=S_USER_INPUT.naz;
  thetao=S_USER_INPUT.thetao;
  Swing=S_USER_INPUT.Swing;
  bwing=S_USER_INPUT.bwing;
  CLwing=S_USER_INPUT.CLwing;
    CDowing=S_USER_INPUT.CDowing;
    ewing=S_USER_INPUT.ewing;
  afoil=S_USER_INPUT.afoil;
    a=S_USER_INPUT.a;
  b=S_USER_INPUT.b;
  R=S_USER_INPUT.R;
    e=S_USER_INPUT.e;
    grip=S_USER_INPUT.grip;
  rchord=S_USER_INPUT.rchord;
  tr=S_USER_INPUT.tr;
  trst=S_USER_INPUT.trst;
  twist=S_USER_INPUT.twist;
  wblade=S_USER_INPUT.wblade;
    nbe=S_USER_INPUT.nbe;
    Taux=S_USER_INPUT.Taux;
  Afh=S_USER_INPUT.Afh;
  Afv=S_USER_INPUT.Afv;
  Svert=S_USER_INPUT.Svert;
  bvert=S_USER_INPUT.bvert;
    CLvert=S_USER_INPUT.CLvert;
    CDovert=S_USER_INPUT.CDovert;
  Shoriz=S_USER_INPUT.Shoriz;
  bhoriz=S_USER_INPUT.bhoriz;
  CLhoriz=S_USER_INPUT.CLhoriz;
  CDohoriz=S_USER_INPUT.CDohoriz;
  taildisk=S_USER_INPUT.taildisk;
  tailrot=S_USER_INPUT.tailrot;
```

```
CON_R=S_USER_INPUT.CON_R;
CON_chord=S_USER_INPUT.CON_chord;
CON_b=S_USER_INPUT.CON_b;
CON_omega=S_USER_INPUT.CON_omega;
CON_cd=S_USER_INPUT.CON_cd;
CON_lt=S_USER_INPUT.CON_lt;
```

APPENDIX AL. UNSTRUCTURE2.M

This script M-file decomposes the S_PERF_OUTPUT structure into 25 separate output parameters. These variables are displayed in the performance output figure window.

```
% unstructure2.m

% Structure De-Consruction for JANRAD98 performance_output.m
% JANRAD 98 VERSION 5.0

 Dfuse=S_PERF_OUTPUT.Dfuse;
 Hrotor=S_PERF_OUTPUT.Hrotor;
 Lwing=S_PERF_OUTPUT.Lwing;
 Dwing=S_PERF_OUTPUT.Dwing;
 Lhoriz=S_PERF_OUTPUT.Lhoriz;
 Dhoriz=S_PERF_OUTPUT.Lhoriz;
 Lvert=S_PERF_OUTPUT.Lvert;
 Dvert=S_PERF_OUTPUT.Dvert;
 alphaT=S_PERF_OUTPUT.alphaT;
 betao=S_PERF_OUTPUT.betao;
 rT2=S_PERF_OUTPUT.rT2;
   thetao=S_PERF_OUTPUT.thetao;
   theta1c=S_PERF_OUTPUT.theta1c;
 theta1s=S_PERF_OUTPUT.theta1s;
   solidity=S_PERF_OUTPUT.solidity;
 DL=S_PERF_OUTPUT.DL;
 FM=S_PERF_OUTPUT.FM;
   CT_sig=S_PERF_OUTPUT.CT_sig;
   CQ_sig=S_PERF_OUTPUT.CQ_sig;
 CH_sig=S_PERF_OUTPUT.CH_sig;
 Machtip=S_PERF_OUTPUT.Machtip;
 mu=S_PERF_OUTPUT.mu;
 T=S_PERF_OUTPUT.T;
 Protor=S_PERF_OUTPUT.Protor;
   Qrotor=S_PERF_OUTPUT.Qrotor;
```

APPENDIX AM. UNSTRUCTURE3.M

This script M-file decomposes the S_MATR_VEC structure for use in the print and save commands.

```
% unstructure3.m

% Structure De-Consnruction for JANRAD98
% JANRAD 98 VERSION 5.0

   r= S_MATR_VEC.r;
   dr=S_MATR_VEC.dr;
   psi= S_MATR_VEC.psi;
   vi= S_MATR_VEC.vi;
   theta= S_MATR_VEC.theta;
   betat= S_MATR_VEC.betat;
   alpha= S_MATR_VEC.alpha;
   Tpsi= S_MATR_VEC.Tpsi;
   Npsi= S_MATR_VEC.Npsi;
   Mpsi= S_MATR_VEC.Mpsi;
   DMpsi= S_MATR_VEC.DMpsi;
   dT= S_MATR_VEC.dT;
   dN= S_MATR_VEC.dN;
   dM= S_MATR_VEC.dM;
   dD= S_MATR_VEC.dD;
   cblade= S_MATR_VEC.cblade;
   CL= S_MATR_VEC.CL;
   CD= S_MATR_VEC.CD;
   Reff= S_MATR_VEC.Reff;
```

APPENDIX AN. UNSTRUCTURE5.M

This script M-file decomposes the S_FIT_TR structure for use in Perf.m

```
% unstructure5.m

% Structure De-Consruction for JANRAD98 compound_tailrotor.m
% JANRAD 98 VERSION 5.0

   FIT_R= S_FIT_TR_INPUT.FIT_R;
   FIT_cd= S_FIT_TR_INPUT.FIT_cd;
   FIT_sigma= S_FIT_TR_INPUT.FIT_sigma;
   FIT_omega= S_FIT_TR_INPUT.FIT_omega;
   FIT_lt= S_FIT_TR_INPUT.FIT_lt;
```

APPENDIX AO. PERF.M

This script M-file is the primary computational routine for JANRAD 98. It is launched from either the iteration_method_fcn.m or iteration_parameter_fcn.m Switchyard Callback function.

```
% Perf.m

% Main Performance computation routine.
% JANRAD 98 VERSION 5.0

global S_PERF_INPUT S_PERF_OUTPUT S_MATR_VEC H_RADSPC NL_TWIST_VAL

if S_PERF_INPUT.grip < 1e-10,
  S_PERF_INPUT.grip=1e-10;
end

if S_PERF_INPUT.Swing < 1e-10,
  S_PERF_INPUT.Swing=1e-10;
end

if S_PERF_INPUT.bwing < 1e-10,
  S_PERF_INPUT.bwing=1e-10;
end

if S_PERF_INPUT.ewing < 1e-10,
  S_PERF_INPUT.ewing=1e-10;
end

if S_PERF_INPUT.Shoriz < 1e-10,
  S_PERF_INPUT.horiz=1e-10;
end

if S_PERF_INPUT.bhoriz < 1e-10,
  S_PERF_INPUT.bhoriz=1e-10;
end

if S_PERF_INPUT.Svert < 1e-10,
  S_PERF_INPUT.Svert=1e-10;
end

if S_PERF_INPUT.bvert < 1e-10,
  S_PERF_INPUT.bvert=1e-10;
end

S_PERF_INPUT.Vinf=S_PERF_INPUT.Vinf*1.68781;
S_PERF_INPUT.twist=abs(S_PERF_INPUT.twist)/57.3;
S_PERF_INPUT.thetao=S_PERF_INPUT.thetao/57.3;
```

unstructure

```
switch PICK
case 1
  if isempty(MINUM)
    MINUM=0;         % sets min airspeed default to 0 kts
  end
  if isempty(MAXUM)
    MAXUM=160;           % sets max airspeed default to 160 kts
  end
  if isempty(INTER)
    INTER=20;        % sets INTERval default to 20 kts
  end
  if MINUM > MAXUM  % ensures INTERval is the correct sign
    INTER=-abs(INTER);
  else
    INTER=abs(INTER);
  end
   doit1='airspd=itervar;';
   doit2='Vinf=airspd*6080.2/3600;';   % converts kts to ft/s
   m=(MAXUM-MINUM)/INTER+1;  % computes reqd nbr of elements for vectors
   speed=zeros(1,m);        % vector for each airspeed values
   mu=zeros(1,m);           % vector for adv ratio values
   Lperc=zeros(1,m);        % vector for wing lift percent values
   ctonsig=zeros(1,m);      % vector for CT/sigma values
   LoverD=zeros(1,m);           % vector for tot acft W/De
   theone='airspd';

 case 2
   if isempty(MINUM)
     MINUM=0;        % sets min altitude default to 0 ft
   end

        if isempty(MAXUM)
           MAXUM=15000;           % sets max altitude default to 15000 ft
      end

     if isempty(INTER),
      INTER=1000;        % sets INTERval default to 1000 ft
     end
    if MINUM > MAXUM           % ensures INTERval is the correct sign
      INTER=-abs(INTER);
    else
      INTER=abs(INTER);
    end
  doit1='PA=itervar;';
  doit2='temp = 59-1.9811e-3/.5555*PA;'; % sets correct ISA temp
                              % for given alt (deg F)
                              % note: 59=SLS, 103=trop
  m=(MAXUM-MINUM)/INTER+1;  % computes reqd nbr of elements for vectors
  altitude=zeros(1,m);
```

```
  theone='PA';

case 3
    if isempty(MINUM)
        MINUM=10000;      % sets min GW default to 10000 lbs
      end
   if isempty(MAXUM)
        MAXUM=20000;          % sets max airspeed default to 20000 lbs
      end

    if isempty(INTER),
     INTER=2000;        % sets INTERval default to 2000 lbs
    end
   if MINUM > MAXUM          % ensures INTERval is the correct sign
    INTER=-abs(INTER);
   else
    INTER=abs(INTER);
   end
  doit1='GW=itervar;';
  doit2=' ';
  m=(MAXUM-MINUM)/INTER+1; % computes reqd nbr of elements for vectors
  wt=zeros(1,m);          % vector for GW values
  Tcoeff=zeros(1,m);          % vector for Coeff of Thrust values
  Pcoeff=zeros(1,m);          % vector for Coeff of Power values
  figmrt=zeros(1,m);      % vector for Figure of Merit values
  theone='GW';
  if REGIME==1&PA==0&Vinf<=16.9
    Ptige=zeros(1,m);
  end

case 4
    if isempty(MINUM)
        MINUM=0;      % sets min blade twist default to 0 deg
      end
      if isempty(MAXUM)
        MAXUM=-12;        % sets max blade twist default to -12 deg
      end
   if isempty(INTER),
    INTER=-2;      % sets INTERval default to -2 deg
   end
  if MINUM > MAXUM      % ensures INTERval is the correct sign
    INTER=-abs(INTER);
  else
    INTER=abs(INTER);
  end
 doit1='TWIST=itervar;';
 doit2='twist=abs(TWIST)/57.3;';
 m=abs(MAXUM-MINUM)/abs(INTER); % computes reqd nbr of elements for vectors
 thetat=zeros(1,m);        % vector for blade twist values
 theone='TWIST';

case 5
   if isempty(MINUM)
```

```
        MINUM=1;       % sets min blade taper ratio default to 1
      end
      if isempty(MAXUM)
        MAXUM=0.5;         % sets max blade taper ratio default to 0.5
      end
   if isempty(INTER),
     INTER=-0.1;       % sets INTERval default to -0.1
   end
  if MINUM > MAXUM          % ensures INTERval is the correct sign
    INTER=-abs(INTER);
  else
    INTER=abs(INTER);
  end
 doit1='tr=itervar;';
 doit2=' ';
 m=abs(MAXUM-MINUM)/INTER+1;   % computes reqd nbr of elements for vectors
 taper=zeros(1,m);       % vector for blade taper ratio values
 theone='tr';

case 6
   if isempty(MINUM)
        MINUM=0.1;         % sets min blade twist default to 0.1 r/R
      end
      if isempty(MAXUM)
        MAXUM=0.9;         % sets max blade twist default to 0.9 r/R
      end
   if isempty(INTER),
     INTER=0.1;         % sets INTERval default to 0.1 r/R
   end
  if MINUM > MAXUM     % ensures INTERval is the correct sign
    INTER=-abs(INTER);
  else
    INTER=abs(INTER);
  end
 doit1='trst=itervar;';
 doit2=' ';
 m=abs(MAXUM-MINUM)/INTER+1;   % computes reqd nbr of elements for vectors
 start=zeros(1,m);       % vector for taper ratio start position values
 theone='trst';

case 7
   if isempty(MINUM)
        MINUM=50;          % sets min wing area default to 50 sq ft
      end
      if isempty(MAXUM)
        MAXUM=80;          % sets max wing area default to 80 sq ft
      end
   if isempty(INTER),
     INTER=5;       % sets INTERval default to 5 sq ft
   end
  if MINUM > MAXUM          % ensures INTERval is the correct sign
    INTER=-abs(INTER);
  else
```

```
    INTER=abs(INTER);
  end
  if isempty(AR)
    AR=6;     % sets aspect ratio default to 6
  end
 doit1='Swing=itervar;';
 doit2='bwing=sqrt(AR*Swing);';     % computes wing span given AR and wing area
 m=abs(MAXUM-MINUM)/INTER+1;   % computes reqd nbr of elements for vectors
 area=zeros(1,m);               % vector for wing area values
 theone='Swing';

case 8
   if isempty(MINUM)
       MINUM=20;            % sets min main rotor radius to 20 feet
      end
      if isempty(MAXUM)
        MAXUM=36;           % sets max main rotor radius to 36 feet
      end
   if isempty(INTER),
     INTER=2;      % sets INTERval default to 2 feet
   end
  if MINUM > MAXUM     % ensures INTERval is the correct sign
    INTER=-abs(INTER);
  else
    INTER=abs(INTER);
  end
 doit1='R=itervar;';
 doit2=' ';
 m=abs(MAXUM-MINUM)/INTER+1;   % computes reqd nbr of elements for vectors
 mrb_radius=zeros(1,m);          % vector for rotor radius values
 theone='R';

case 9
   if isempty(MINUM)
     MINUM=20;          % sets min main rotor spd to 20 rad/sec
   end
      if isempty(MAXUM)
        MAXUM=36;         % sets max main rotor spd to 36 rad/sec
      end
   if isempty(INTER),
     INTER=2;      % sets INTERval default to 2 rad/sec
   end
  if MINUM > MAXUM     % ensures INTERval is the correct sign
    INTER=-abs(INTER);
  else
    INTER=abs(INTER);
  end
 doit1='omega=itervar;';
 doit2=' ';
 m=abs(MAXUM-MINUM)/INTER+1;   % computes reqd nbr of elements for vectors
 rot_spd=zeros(1,m);          % vector for rotor speed values
 theone='omega';
```

```
  case 0
    MINUM=1;  %\
    MAXUM=1;  % > using these values the for loop is effectively
    INTER=1;  %/       non-existent - will go through only once
    doit1=' ';
    doit2=' ';
  end

%%% common vectors for compilation of iterative data %%%
if PICK~=0
  thrust=zeros(1,m);
  auxthrust=zeros(1,m);
  RHP=zeros(1,m);
  Totpwr=zeros(1,m);
  angle=zeros(1,m);
  Drag=zeros(1,m);
  RotDrag=zeros(1,m);
  Wingdrag=zeros(1,m);
  Winglift=zeros(1,m);
  coll_pit=zeros(1,m);
  lat_coeff=zeros(1,m);
  long_coeff=zeros(1,m);
  Auxpwr=zeros(1,m);
  diskload=zeros(1,m);
  Afv1=zeros(1,m);
  rot_spd=zeros(1,m);
end


switch tailrot
case 1
   %%% vectors for Conventional Tail calculations %%%
   if PICK~=0
     thrtail=zeros(1,m);
     pwrtail=zeros(1,m);
   end
  Atail = pi*CON_R^2;          % Area of tail
  Atailbl=2*CON_R*CON_chord;
  sigmatail = Atailbl/Atail;     % Solidity of tail
case 2

  %%% vectors for Fan-In Tail calculations %%%
  if PICK~=0
    Tfin=zeros(1,m);
    Tfan=zeros(1,m);
    pwrfani=zeros(1,m);
    pwrfanp=zeros(1,m);
    pwrfant=zeros(1,m);
   end
   %%% Fan-in-Tail Parameters %%%
   unstructure5
   Afan = pi*FIT_R^2;          % Area of fan
```

```
case 3
end


%%% Beginning of Iteration Loop %%%
p=0;
for itervar = MINUM:INTER:MAXUM
  eval(doit1) % reads and evaluates the string 'doit1' assigned above
         % assigns itervar to the reqd var needed to complete iteration
  eval(doit2) % reads and evaluates the string 'doit2' assigned above
         % used if input variable needs some type of manipulation
  p=p+1;          % used to move to next vector element
  set(H_STATUS,'String','ROTOR PERFORMANCE ROUTINE')
  tic
  set(H_STATUS1,'String','START ELAPSED TIME')
  pause(3)
  %%% account for vertical drag on wing and horizontal tail %%%
    if taildisk==1
      Afv1=Afv+3*(Swing+Shoriz);    % this assumes a vertical Cd of 1.2 for the
    elseif taildisk==2       % wing and horiz tail and a vertical Cd of
      Afv1=Afv+3*Swing       % 0.4 for the fuselage (i.e. 1.2/.4 = 3)
    end                % thus making wing/tail effectively larger
               % when hvr thrust calc using Cd=0.4
  trim

  %%%  *** Calculation of output parameters ***  %%%

  load perftemp  % Eccles addition - program was not recognizing
          % mchord and DMpsi.
  Paux=(Taux*Vinf)/(550*AUXEFF);  %Auxiliary Power reqd
  Protor=mean(DMpsi)*b*omega/550;  % Rotor pwr reqd, NOT total pwr
  Qrotor=mean(DMpsi)*b;          % Rotor torque reqd
  solidity=b*mchord/(pi*R);
  CQ=Qrotor/(Adisk*rho*Vtip^2*R);
  CH=Hrotor/(Adisk*rho*Vtip^2);
  CT_sig=CT/solidity;
  CQ_sig=CQ/solidity;
  CH_sig=CH/solidity;
  Machtip=(Vtip*cos(alphaT)+Vinf)/(49.05*sqrt(temp+460));
  if Vinf < 16.9,
    DL=T/(pi*R^2);
    FM=(T*sqrt(DL/(2*rho)))/(550*Protor);
  else
    DL=0;
    FM=0;
  end
  switch tailrot
  case 1
  %%%% Conventional Tail Rotor Power Calculations
  Thrustt= Qrotor/CON_lt;   % Thrust reqd for anti-torque
  vit=sqrt(Thrustt/2*rho*Atail);
  Ptail=(Thrustt*vit/550)+(((rho*Atailbl*((CON_omega*CON_R)^3)*CON_cd/8)/550)*(1+3*mu^2));
  Pacc = 106.25+0.01275*Protor;           % Pwr for accessories
```

```
  Ptot = Protor+Ptail+Pacc+Paux;            % Total pwr reqd
  CP=Ptot*550/(Adisk*rho*Vtip^3);               % Coefficient of Pwr based on Ptot
  case 2
  %%%% Compute Fan and Access/Xmsn Power Reqd in Fwd Flt %%%%
  vifan = abs(sqrt((Qrotor/FIT_lt-Lvert)/(rho*Afan))); % use abs in case complex
                              (Qrotor/FIT_lt-Lvert<0);
  Thrustf = Qrotor/FIT_lt;              % Thrust reqd for anti-torque
  Pfani = 0.5*rho*Afan*vifan^3/550;         % Fan induced pwr
  Pfanp = rho*Afan*Vtip^3*FIT_sigma*FIT_cd/4400;   % Fan profile pwr
  Pacc = 106.25+0.01275*Protor;             % Pwr for accessories
  Ptot = Protor+Pfani+Pfanp+Pacc;           % Total pwr reqd
  CP=Ptot*550/(Adisk*rho*Vtip^3);               % Coefficient of Pwr based on Ptot
  case 3
  end

%%%% HIGE total pwr %%%%
if REGIME==1
 viave=sqrt(DL/(2*rho));            % Induced vel - hoge
 delpwr=T*viave*0.23/550;               % Decr in pwr due to grd effect
 Prtrige=Protor-delpwr;             % Rotor pwr - hige
 Tige=Prtrige*550/(omega*lfan);         % Rotor thrust - hige
 vifige=sqrt(Tige/(rho*Afan));          % Induce vel - hige
 Pfanige=0.5*rho*Afan*vifige^3/550;         % Fan pwr - hige
 Paccige=106.25+0.01275*Prtrige;        % Access pwr - hige
 Ptotige=Prtrige+Pfanige+Pfanp+Paccige;  % Tot pwr - hige
end

WonDe=GW/(550*Ptot/(Vinf+.1));       % Total acft W/De (lift/drag)
                       % .1 added for case when Vinf=0
%%% Collecting and vectoring all the calculated data %%%
%%% vectors specific to desired iteration
switch PICK
case 1
 speed(p)=airspd;      % vector of airspeeds
 mu(p)=Vinf/Vtip;      % vector of advance ratios
 ctonsig(p)=CT_sig;  % vector of CT on sigma
 LoverD(p)=WonDe; % vector of W/De
 rot_spd(p)=omega;  % vector of main rotor speeds

case 2
 altitude(p)=PA; % vector of altitudes

case 3
 wt(p)=GW;                 % vector of GW

case 4
 thetat(p)=TWIST;    % vector of blade twist

case 5
 taper(p)=tr;       % vector of taper ratio

case 6
 start(p)=trst;     % vector of starting position of blade taper
```

```
case 7
  area(p)=Swing;  % vector of wing wetted area
case 8
  mrb_radius(p)=R;  % vector of main rotor radius
case 9
  rot_spd(p)=omega;  % vector of main rotor speeds
end
if REGIME==1
  Ptige(p)=Ptotige;      % vector of total hp in hige
end

%%% vectors common to all iterations
if PICK~=0
  thrust(p)=T;      % vector of main rotor thrust
  auxthrust(p)=Taux; % vector of Aux Thrust
  RHP(p)=Protor  % vector of rotor hp reqd
  Totpwr(p)=Ptot  % vector of total hp reqd
  Auxpwr(p)=Paux;  % vector of Aux hp rqd
  angle(p)=alphaT*57.3;   % vector of tip path plane angle
  Wingdrag(p)=Dwing;   % vector of wing drag
  Drag(p)=Drotor+Dfuse+Dvert+Dhoriz+Dwing; % vector of tot acft drag
  Winglift(p)=Lwing;  %vector of wing lift
  Tfin(p)=Lvert;  % vector of vertical fin lift
  Lperc(p)=Lwing/GW*100;% vector wing lift percentage
  if tailrot==1
    thrtail(p)=Thrustt;  % vector of tail thrust
    pwrtail(p)=Ptail;  % vector of tail power
  else tailrot==2
    Tfan(p)=Qrotor/lfan;   % vector of fan thrust
    pwrfani(p)=Pfani;  % vector of fan induced pwr
    pwrfanp(p)=Pfanp;% vector of fan profile pwr
    pwrfant(p)=Pfani+Pfanp;    % vector of fan total pwr
  end

  Rotdrag(p)=Hrotor      % vector of rotor drag
  Tcoeff(p)=CT;          % vector of Coefficient of Thrust
  Pcoeff(p)=CP;          % vector of Coefficient of Power
  figmrt(p)=FM;          % vector of Figure of Merit
  diskload(p)=DL;   % vector of Disk Loading
  coll_pit(p)=thetao*57.3;    %vector of collective pitch@.7R
  lat_coeff(p)=theta1c*57.3;  %vector of 1st lateral cyclic term
  long_coeff(p)=theta1s*57.3;  %vector of 1st longitudinal cyclic term

  %eval('theone'); % displays current value of iterative variable
end            % 'end' needed to complete the 'for' loop
end % this is the 'end' needed to complete the 'for' loop

%%%% Save iteration data for future processing %%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%% format: save <filename> var1 var2 var3                       %
%%%% (note: all variables must be valid or will get error)        %
%%%% Works well to create short m-file to graph this calculated data    %
%%%%  just use 'load <filename>' at the beginning of the file to       %
```

```
%%%  read all the vectors which are stored in the .mat file          %
if PICK~=0
  save output Totpwr angle RHP thrust Wingdrag Drag Rotdrag coll_pit lat_coeff long_coeff...
    figmrt Tcoeff Pcoeff Winglift Auxpwr auxthrust Lperc diskload
  if tailrot==1
    save tailop thrtail pwrtail
  else
    save tailop Tfin Tfan pwrfani pwrfanp pwrfant
  end
end
switch PICK
case 1
  save extra1 speed mu ctonsig LoverD Lperc RHP Tcoeff Pcoeff...
      figmrt m rot_spd

case 2
 save extra2 altitude

case 3
  save extra3 wt Tcoeff Pcoeff figmrt

case 4
 save extra4 thetat

case 5
 save extra5 taper

case 6
 save extra6 start

case 7
 save extra7 area
case 8
 save extra8 mrb_radius
case 9
 save extra9 rot_spd
end
if REGIME==1
 save extra10 Ptige
end

set(H_STATUS,'String','COMPLETING CALCULATIONS ...')
set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
pause(3)
fid=fopen('print_temp','w+');
fprintf(fid,'\t                *** MODIFIED USER INPUT ***\n\n');
fprintf(fid,'\t                 Forward velocity = %6.0f kts\n',Vinf/1.69);
fprintf(fid,'\t                      Temperature = %6.0f degs F\n',temp);
fprintf(fid,'\t                Pressure altitude = %6.0f ft\n',PA);
fprintf(fid,'\t                     Gross weight = %6.0f lbs\n',GW);
fprintf(fid,'\t                 Number of blades = %6.0f \n',b);
fprintf(fid,'\t                     Rotor radius = %6.2f ft\n',R);
fprintf(fid,'\t                 Blade root chord = %6.2f ft\n',rchord);
```

```
if NL_TWIST_VAL==1
  fprintf(fid,'\t                Blade twist = \n');
  fprintf(fid,'\t                       %6.2f degs\n',NL_TWIST*57.3);
else
  fprintf(fid,'\t                Blade twist = %6.2f degs\n',-1*twist*57.3);
end
fprintf(fid,'\t          Blade lift curve slope = %6.2f \n',a);
fprintf(fid,'\t               Blade weight = %6.2f lbs\n',wblade);
fprintf(fid,'\t           Rotational velocity = %6.2f rads/sec\n',omega);
fprintf(fid,'\t             Blade grip length = %6.2f ft\n',grip);
fprintf(fid,'\t                Hinge offset = %6.2f ft\n',e);
fprintf(fid,'\t        Equivalent flat plate area = %6.2f ft^2\n',Afh);
fprintf(fid,'\t         Vertical projected area = %6.2f ft^2\n',Afv);
fprintf(fid,'\t                  Wing area = %6.2f ft^2\n',Swing);
fprintf(fid,'\t                  Wing span = %6.2f ft\n',bwing);
fprintf(fid,'\t                   Wing CL = %6.2f \n',CLwing);
fprintf(fid,'\t                   Wing CDo = %6.4f \n',CDowing);
fprintf(fid,'\t          Wing efficiency factor = %6.2f \n',ewing);
fprintf(fid,'\t           Horizontal tail area = %6.2f ft^2\n',Shoriz);
fprintf(fid,'\t           Horizontal tail span = %6.2f ft\n',bhoriz);
fprintf(fid,'\t             Horizontal tail CL = %6.2f \n',CLhoriz);
fprintf(fid,'\t            Horizontal tail CDo = %6.4f \n',CDohoriz);
fprintf(fid,'\t             Vertical tail area = %6.2f ft^2\n',Svert);
fprintf(fid,'\t             Vertical tail span = %6.2f ft\n',bvert);
fprintf(fid,'\t               Vertical tail CL = %6.2f \n',CLvert);
fprintf(fid,'\t              Vertical tail CDo = %6.4f \n',CDovert);
fprintf(fid,'\t               Auxiliary thrust = %6.0f lbs\n',Taux);
fprintf(fid,'\t             Number of Azimuths = %6.0f \n',naz);
fprintf(fid,'\t               Collective Pitch = %6.2f degs\n',thetao*57.3);
fprintf(fid,'\t                  Airfoil Type = %6.0f \n',afoil);
fprintf(fid,'\t                   Taper Ratio = %6.2f \n',tr);
fprintf(fid,'\t          Taper Ratio Starts At = %6.2f ft\n',trst);
fprintf(fid,'\t        Number of Blade Elements = %6.0f \n',nbe);
fprintf(fid,'\t Tail Under Main Rotor (1-yes 2-no) = %6.0f \f',taildisk);
fclose(fid);


%  *** output to disk (text file) ***


fid=fopen('print_temp1','w+');
fprintf(fid,'\t               *** RESULTS ***\n\n');
fprintf(fid,'\t          Forward velocity = %6.0f kts\n',Vinf/1.69);
fprintf(fid,'\t              Temperature = %6.0f degs F\n',temp);
fprintf(fid,'\t         Pressure altitude = %6.0f ft\n',PA);
fprintf(fid,'\t             Gross weight = %6.0f lbs\n',GW);
fprintf(fid,'\t          Number of blades = %6.0f \n',b);
fprintf(fid,'\t             Rotor radius = %6.2f ft\n',R);
fprintf(fid,'\t          Blade mean chord = %6.2f ft\n',mchord);
if NL_TWIST_VAL==1
  fprintf(fid,'\t                Blade twist = \n');
  fprintf(fid,'\t                       %6.2f degs\n',NL_TWIST*57.3);
else
```

```
  fprintf(fid,'\t                    Blade twist = %6.2f degs\n',-1*twist*57.3);
end
fprintf(fid,'\t        Blade lift curve slope = %6.2f \n',a);
fprintf(fid,'\t                  Blade weight = %6.2f lbs\n',wblade);
fprintf(fid,'\t           Rotational velocity = %6.2f rads/sec\n',omega);
fprintf(fid,'\t             Blade grip length = %6.2f ft\n',grip);
fprintf(fid,'\t                  Hinge offset = %6.2f ft\n',e);
fprintf(fid,'\t Equivalent flat plate area = %6.2f ft^2\n',Afh);
fprintf(fid,'\t      Vertical projected area = %6.2f ft^2\n',Afv);
fprintf(fid,'\t                     Wing area = %6.2f ft^2\n',Swing);
fprintf(fid,'\t                     Wing span = %6.2f ft\n',bwing);
fprintf(fid,'\t                       Wing CL = %6.2f \n',CLwing);
fprintf(fid,'\t                      Wing CDo = %6.4f \n',CDowing);
fprintf(fid,'\t        Wing efficiency factor = %6.2f \n',ewing);
fprintf(fid,'\t          Horizontal tail area = %6.2f ft^2\n',Shoriz);
fprintf(fid,'\t          Horizontal tail span = %6.2f ft\n',bhoriz);
fprintf(fid,'\t            Horizontal tail CL = %6.2f \n',CLhoriz);
fprintf(fid,'\t           Horizontal tail CDo = %6.4f \n',CDohoriz);
fprintf(fid,'\t            Vertical tail area = %6.2f ft^2\n',Svert);
fprintf(fid,'\t            Vertical tail span = %6.2f ft\n',bvert);
fprintf(fid,'\t              Vertical tail CL = %6.2f \n',CLvert);
fprintf(fid,'\t             Vertical tail CDo = %6.4f \n',CDovert);
fprintf(fid,'\t                 Fuselage drag = %6.0f lbs\n',Dfuse);
fprintf(fid,'\t                    Rotor drag = %6.0f lbs\n',Hrotor);
fprintf(fid,'\t                     Wing lift = %6.0f lbs\n',Lwing);
fprintf(fid,'\t                     Wing drag = %6.0f lbs\n',Dwing);
fprintf(fid,'\t          Horizontal tail lift = %6.0f lbs\n',Lhoriz);
fprintf(fid,'\t          Horizontal tail drag = %6.0f lbs\n',Dhoriz);
fprintf(fid,'\t      Vertical tail side force = %6.0f lbs\n',Lvert);
fprintf(fid,'\t            Vertical tail drag = %6.0f lbs\n',Dvert);
fprintf(fid,'\t              Auxiliary thrust = %6.0f lbs\n',Taux);
fprintf(fid,'\t                Tip path angle = %6.2f degs\n',alphaT*57.3);
fprintf(fid,'\t            Rotor coning angle = %6.2f degs\n',betao*57.3);
fprintf(fid,'\tLocation of mean thrust (r/R) = %6.2f \n',rT2);
fprintf(fid,'\t   Collective pitch at .7 r/R = %6.2f degs\n',thetao*57.3);
fprintf(fid,'\t 1st lat cyclic term-A1 (deg) = %6.2f \n',theta1c*57.3);
fprintf(fid,'\t1st long cyclic term-B1 (deg) = %6.2f \n',theta1s*57.3);
fprintf(fid,'\t                      solidity = %6.3f \n',solidity);
fprintf(fid,'\t                  Disk loading = %6.2f lbs/ft^2\n',DL);
fprintf(fid,'\t              Figure of Merit = %6.2f \n',FM);
fprintf(fid,'\t                     CT/sigma = %6.3f \n',CT_sig);
fprintf(fid,'\t                     CQ/sigma = %6.4f \n',CQ_sig);
fprintf(fid,'\t                     CH/sigma = %6.4f \n',CH_sig);
fprintf(fid,'\t Tip mach of the adv. blade = %6.3f \n',Machtip);
fprintf(fid,'\t                Advance ratio = %6.3f \n',mu);
fprintf(fid,'\t Rotor thrust required (TPP) = %6.0f lbs\n',T);;
fprintf(fid,'\t         Rotor power required = %6.0f h.p.\n',Protor);
fprintf(fid,'\t                 Rotor torque = %6.0f ft-lbs\f',Qrotor);
fclose(fid);
%  *** Configuring variables for output ***

theta=theta*57.3;
%betat=[betat twist*(0.7-(Reff+(R-Reff)/2)/R)]*57.3;
```

```
alpha=alpham*57.3;,alpha=[alpha zeros(size(psi))];
Mpsi=Mpsi(:,length(Mpsi(1,:))-1);
dM=[dM ddM];
psi=psi*57.3;
r=[r (R-(R-Reff)/2)];
vi=[vi 0];

set(H_STATUS,'String','STAND BY FOR OUTPUT...')
pause(3)

structure1
structure2
set(H_STATUS,'String','')
performance_output
close(H_IT_METH)
```

APPENDIX AP. TRIM.M

This script M-file is a subroutine to trim the rotor system. It is called in Perf.m.

```
% Trim.m

% Trim routine for collective/cyclic.
% JANRAD 98 VERSION 5.0

global RADSPC_VAL NL_TWIST_VAL NEW_AUX_VAL FIX_TPP_VAL NEW_TPP


if get(H_AS,'Value')==1
  IT_PARAM='AIRSPEED';
  IT_UNIT='KTS';
elseif get(H_AL,'Value')==1
  IT_PARAM='ALTITUDE';
  IT_UNIT='FT';
elseif get(H_GW,'Value')==1
  IT_PARAM='GROSS WEIGHT';
  IT_UNIT='LBS';
elseif get(H_BT,'Value')==1
  IT_PARAM='BLADE TWIST';
  IT_UNIT='DEG';
elseif get(H_BTR,'Value')==1
  IT_PARAM='BLADE TAPER RATIO';
  IT_UNIT='';
elseif get(H_SOT,'Value')==1
  IT_PARAM='START OF TAPER';
  IT_UNIT='FT';
elseif get(H_WSA,'Value')==1
  IT_PARAM='WING SPAN AREA';
  IT_UNIT='FT^2';
elseif get(H_RBR,'Value')==1
  IT_PARAM='ROTOR BLADE RADIUS';
  IT_UNIT='FT';
elseif get(H_RBS,'Value')==1
  IT_PARAM='ROTOR BLADE SPEED';
  IT_UNIT='RAD/SEC';
end
set(H_STATUS,'String','EXECUTING ROTOR TRIM ROUTINE')
set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
if get(H_NI,'Value')==1
  set(H_STATUS3,'String','')
else
  set(H_STATUS3,'String',['ITERATION PARAMETER: ' IT_PARAM ' = ' num2str(itervar)
num2str(IT_UNIT)])
end
pause(3)
```

```
% *** calculation of required parameters ***

rho=.002377*(-.000031*PA+(-.002*temp+1.118))

% *** first guess at rotor profile drag ( H force) ***

if Vinf < 16.9,

 Drotor=0;

else

 Drotor=Vinf*(rho/.002377);

end

q=0.5*rho*Vinf^2;

Adisk=pi*R^2;

Vtip=omega*R;
temp_rank=temp+459.67;
spd_snd=49.1*sqrt(temp_rank);
Dfuse=q*Afh;

CDwing=CDowing+(CLwing^2/(ewing*pi*(bwing^2/Swing)));

CDhoriz=CDohoriz+(CLhoriz^2/(.8*pi*(bhoriz^2/Shoriz)));

CDvert=CDovert+(CLvert^2/(.8*pi*(bvert^2/Svert)));

Dwing=q*CDwing*Swing;

Dhoriz=q*CDhoriz*Shoriz;

Dvert=q*CDvert*Svert;
AUXEFF=.7;
if NEW_AUX_VAL==1
  Dftotal=(Dfuse+Dwing+Dhoriz+Dvert);
  if Vinf<16.9
    Taux=0;
  else
    Taux=Dftotal;
  end
  S_PERF_INPUT.Taux=Taux;
  S_USER_INPUT.Taux=Taux;
else
  Dftotal=(Dfuse+Dwing+Dhoriz+Dvert)-Taux
end
Lwing=q*CLwing*Swing

Lhoriz=q*CLhoriz*Shoriz;
```

```
Lvert=q*CLvert*Svert;

Lftotal=Lwing+Lhoriz+Lvert;
if FIX_TPP_VAL==1
  alphaT=NEW_TPP;     %set tip path angle
else
  alphaT=atan2((Dftotal+Drotor),(GW-Lftotal));
end
mu=Vinf*cos(alphaT)/Vtip;

if Vinf < 16.9,
  T=1.05*GW

 else

   T=(GW-Lftotal)/cos(alphaT)
 end

 CT=T/(Adisk*rho*Vtip^2);
%      Values to check output
%   *** setup blade radius elements, azimuth elements,

%      induced velocity distributions, and determination

%      of coning angle and tip loss parameter ***

B=1-(sqrt(2*CT)/b);

Reff=B*R;

Rbar=Reff-e;

if RADSPC_VAL==1
  NEW_r1=[NEW_r, Reff/R];
  n=length(NEW_r1);
  dr=diff(NEW_r1)*R;
  r=(NEW_r1(1:n-1)*R)+dr/2;
else
  dr=(Reff-grip)/nbe;
  r=grip:dr:Reff-dr;,r=r+dr/2;
end
if NL_TWIST_VAL==1
  NL_TWIST=NL_TWIST/57.3;
  n=length(NL_TWIST);
  if RADSPC_VAL==1
    y=((Reff/R)-NEW_r(n))*((NL_TWIST(n)-NL_TWIST(n-1))/(NEW_r(n)- NEW_r(n-1)));
  else
    y=((Reff/R)-r(n))*((NL_TWIST(n)-NL_TWIST(n-1))/(r(n)- r(n-1)));
  end
  NL_TWIST1=[NL_TWIST (NL_TWIST(n)+y)];
  m=length(NL_TWIST1);
  dTW=diff(NL_TWIST1);
  twist=(NL_TWIST1(1:m-1))+dTW/2;
```

```
  betat=twist;
 else
  betat=twist*(0.7-(r/R));

 end
 rT1=0.7;,% *** first guess at rT ***

 RbarT=rT1*Rbar;

 mblade=wblade/32.17;

 betao=asin((T/b*RbarT-(.5*(R-e)+e)*wblade)/((.5*(R-e)+e)^2*omega^2*mblade));

 psi=0:360/naz:360-360/naz;,psi=psi'/57.3;

 %% set up vector of blade element chords and then varies them as

 %%  requested with the blade taper and blade taper start position

 %%  rchord=root chord

 %%  cblade=vector of blade element chord lengths

 %%  tr=taper ratio (tip/root)

 %%  trst=taper ratio start position (r/R)

 cblade=rchord*ones(size(r));    % gives all elements same chord length initially

 if tr==0  % prevents division by zero later in code

   tr=1;  %  in case 0 is enter for taper ratio instead

 end        %  of 1 for no taper

 if trst==0

   slope=(rchord-rchord*tr)/(Reff-grip); % Modifies each element

   cblade=cblade-slope*(r-grip);           %  chord length wrt input

   tchord=cblade(nbe);                     %  taper ratio which has been

   mchord=sum(cblade)/nbe;                 %  been converted into a slope

                              %  top portion takes into

 else                         %  account the possibility that

   slope=(rchord-rchord*tr)/(R*(1-trst));%  a 0 start position is really at

   z=fix(nbe*trst);                  %  the start of the aero portion
```

```
    if z<=1         % prevents beginning index fm being zero
      z=1;
    end
   cblade(z:nbe)=cblade(z:nbe)-(r(z:nbe)-r(z))*slope;
   tchord=cblade(nbe);
   mchord=sum(cblade)/nbe;
end
%   *** induced velocity determination ***
 if Vinf < 16.9,
   A=4*pi;
   Bv=(b/2)*omega*a.*cblade;
   Tv=0;
   delT=T-Tv;
   while abs(delT) > .01*T% Prouty Eqns for Hover
     thetav=betat+thetao;
     C=(-b/2).*cblade*omega^2.*r*a.*thetav;
     vi=(-Bv+sqrt(Bv.^2-(4*A*C)))/(2*A);
     dTv=(b/2)*rho*((omega*r).^2)*a.*(thetav-(vi./(omega*r))).*cblade.*dr;
     Tv=sum(dTv);
     delT=T-Tv;
      if delT < 0,
        thetao=thetao-0.5*thetao*abs(delT/T);
      else
        thetao=thetao+0.5*thetao*abs(delT/T);
      end
   end
 else               % Wheatley Eqn for Fwd flt
   lamdaT=0;
```

```
  lamda=1;

  while abs(lamdaT-lamda)>1e-4

        lamda=lamdaT;

        lamdaT=mu*sin(alphaT)+0.5*CT/sqrt(lamdaT^2+mu^2);

  end


  vi=lamdaT*Vtip-Vinf*sin(alphaT);

  vi=vi*ones(size(r));

 end

%  *** first guess at theta ***


theta1c=0.035*((0.0006e-3*Vinf^2+0.244e-3*Vinf)/0.105);

theta1s=-0.087*((0.0006e-3*Vinf^2+0.244e-3*Vinf)/0.105);

theta=thetao+theta1c.*cos(psi)+theta1s.*sin(psi);

%  *** rotor trimming routine ***


set(H_STATUS,'String','TRIMMING COLLECTIVE')
set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
pause(3)
set(H_STATUS2,'String','')
k=1;

error0=(T*.02)+1;

 while abs(error0) > T*.02
  set(H_STATUS2,'String',['COLLECTIVE TRIM ROUTINE IS ON ITERATION # ',num2str(k)])
  set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
  Tpsi=zeros(size(psi));
  Npsi=zeros(size(psi));
  thrcalc
  if k>1,   % Eccles change: These three lines were added.

   error1;

  end
```

```
  error0=T-(mean(Tpsi)*b);

   if error0 < -T*.02,

    thetao=thetao-0.35*thetao*abs(1.5*error0/T)*(1-mu);

   elseif error0 > T*.02,

    thetao=thetao+0.35*thetao*abs(1.5*error0/T)*(1-mu);

   end

  theta=thetao+theta1c.*cos(psi)+theta1s.*sin(psi);

  if k > 1,

   if abs(error0) > abs(error1),

    clc

    trim_warning
    set(H_GO,'Enable','off');
    set(H_RES,'Enable','off');
    set(H_RUPT,'Enable','off');
    set(H_BK,'Enable','on');
    error('*** Did Not Trim ***')
   end

  end

  error1=error0;
  k=k+1;

 end
set(H_STATUS,'String','TRIMMING CYCLIC')
set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
set(H_STATUS2,'String','')
pause(3)
t0=clock;

k=1;

error0=(((T/b)*rT1*(R-grip))*.04)+1;

 while error0 > ((T/b)*rT1*(R-grip))*.04

  set(H_STATUS2,'String',['CYCLIC TRIM ROUTINE IS ON ITERATION # ',num2str(k)])

  set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
  time=etime(clock,t0);

  if time > 15,
```

```
    set(H_STATUS,'String','STILL TRIMMING ...')
    set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
         set(H_STATUS2,'String',['CYCLIC TRIM ROUTINE IS ON ITERATION # ',num2str(k)])
    pause(2)
    t0=clock;

  end

  Mpsi(:,k)=zeros(size(psi));

  tmcalc

  theta=[theta theta(:,k)];

  Mpsi=[Mpsi Mpsi(:,k)];
%  *** calculation of initial dthetadM ***

    if k < 2,

     theta(:,k+1)=theta(:,k)+0.25/57.3;

     Mpsi(:,k+1)=zeros(size(psi));

     k=k+1;

     tmcalc

     k=k-1;

     dthetadM=(theta(:,k+1)-theta(:,k))./(Mpsi(:,k+1)-Mpsi(:,k));

    end

%  *** calculation of M first harmonic parameters ***

  M1c=2*sum(Mpsi(:,k).*cos(psi))/naz;

  M1s=2*sum(Mpsi(:,k).*sin(psi))/naz;

%  *** removal of first harmonic terms from Mpsi ***

  Mpsi(:,k+1)=Mpsi(:,k)-M1c.*cos(psi)-M1s.*sin(psi);

  delM=Mpsi(:,k+1)-Mpsi(:,k);

  error0=max(delM)-min(delM);
  if k > 1,

    if error0 > error1,
      clc
      trim_warning
      set(H_GO,'Enable','off');
      set(H_RES,'Enable','off');
```

```
      set(H_RUPT,'Enable','off');
      set(H_BK,'Enable','on');
      error('*** END OF PROGRAM ***')
    end

  end

  error1=error0;

% *** calculation of new theta ***

  delM=0.5*(1-mu)*delM;

  theta(:,k+1)=theta(:,k)+(dthetadM.*delM);

  if error0 <= ((T/b)*rT1*(R-grip))*.04,

   theta1c=2*sum(theta(:,k).*cos(psi))/naz;

   theta1s=2*sum(theta(:,k).*sin(psi))/naz;

  else

   theta1c=2*sum(theta(:,k+1).*cos(psi))/naz;

   theta1s=2*sum(theta(:,k+1).*sin(psi))/naz;

  end

  theta(:,k+1)=thetao+theta1c.*cos(psi)+theta1s.*sin(psi);
% *** calculation of new dthetadM ***

  theta=[theta theta(:,k+1)];

  Mpsi=[Mpsi Mpsi(:,k+1)];

  theta(:,k+2)=theta(:,k)+0.25/57.3;

  Mpsi(:,k+2)=zeros(size(Mpsi(:,k+1)));

  k=k+2;

  tmcalc

  k=k-2;

  dthetadM=(theta(:,k+2)-theta(:,k))./(Mpsi(:,k+2)-Mpsi(:,k));
  k=k+1;

 end

set(H_STATUS,'String','ADJUSTING COLLECTIVE')
set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
```

```
set(H_STATUS2,'String','')
pause(3)
theta=theta(:,k);

k=1;

error0=(T*.01)+1;

 while abs(error0) > T*.01

  Tpsi=zeros(size(psi));
  Npsi=zeros(size(psi));
  thrcalc

  error0=T-(mean(Tpsi)*b);

   if error0 < -T*.01,

    thetao=thetao-0.25*thetao*abs(1.25*error0/T)*(1-mu);

   elseif error0 > T*.01,

    thetao=thetao+0.25*thetao*abs(1.25*error0/T)*(1-mu);

   end

  theta=thetao+theta1c.*cos(psi)+theta1s.*sin(psi);

  if k > 1,

   if abs(error0) > abs(error1),

    clc
    trim_warning
    set(H_GO,'Enable','off');
    set(H_RES,'Enable','off');
    set(H_RUPT,'Enable','off');
    set(H_BK,'Enable','on');
    error('*** END OF PROGRAM ***')
   end

  end

  error1=error0;

  k=k+1;

 end

 % *** calculating drag moments ***
set(H_STATUS2,'String','CALCULATING DRAG MOMENT')
set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
pause(2)
```

```
DMpsi=zeros(size(psi));

dmcalc
%   *** calculating rotor H force ***

set(H_STATUS2,'String','CALCULATING ROTOR DRAG')
set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
pause(2)
 if Vinf < 16.9,

   Hrotor=0;

   dT=[dT ddT];
   dN=[dN ddN];

   dD=[dD ddD];

 else

   dT=[dT ddT];
   dN=[dN ddN];
   dD=[dD ddD];

    for i=1:length(r)+1,

      H1c(i)=2*sum(dT(:,i).*cos(psi))/naz;

      H1s(i)=2*sum(dD(:,i).*sin(psi))/naz;

    end

   Hrotor=(((b*cos(alphaT)/2)*(sum(H1s)-sin(betao)*sum(H1c)))+Drotor)/2;

end

%   *** calculating new rT ***

rT2=(((mean(Mpsi(:,length(Mpsi(1,:))-1))/mean(Tpsi))/R)+rT1)/2;

%   *** check rotor drag and rT, retrim rotor if required ***

while abs(Drotor-Hrotor) > 0.2*Hrotor | abs(rT1-rT2) > 0.015*rT1

 if abs(Drotor-Hrotor) > 0.2*Hrotor,

   set(H_STATUS,'String','ADJUSTING ROTOR DRAG')
   set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
   set(H_STATUS2,'String',['CURRENT ROTOR DRAG = ' num2str(Drotor) ' LB'])
   pause(3)
 end

 Drotor=Hrotor;
```

```
if abs(rT1-rT2) > 0.015*rT1,

   set(H_STATUS,'String','ADJUSTING MEAN THRUST LOCATION')
   set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
   set(H_STATUS2,'String',['NEW MEAN THRUST LOCATION IS ' num2str(rT2) ' r/R'])
   pause(2)
end
set(H_STATUS,'String','RETRIMMING ROTOR')
set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
pause(3)
set(H_STATUS2,'String','')
dT=dT(:,1:nbe);
dN=dN(:,1:nbe);

dD=dD(:,1:nbe);

%   *** recalculating parameters ***

if FIX_TPP_VAL==1
  alphaT=NEW_TPP;     %set tip path angle
else
  alphaT=atan2((Dftotal+Drotor),(GW-Lftotal));
end
mu=Vinf*cos(alphaT)/Vtip;

if Vinf >= 16.9,        % Wheatley Eqn for Fwd flt

  T=(GW-Lftotal)/cos(alphaT);

  CT=T/(Adisk*rho*Vtip^2);

  lamdaT=0;

  lamda=1;

  while abs(lamdaT-lamda)>1e-4

      lamda=lamdaT;

         lamdaT=mu*sin(alphaT)+0.5*CT/sqrt(lamdaT^2+mu^2);

  end

  vi=lamdaT*Vtip-Vinf*sin(alphaT);

  vi=vi*ones(size(r));
end

B=1-(sqrt(2*CT)/b);

Reff=B*R;

Rbar=Reff-e;
```

```
 if RADSPC_VAL==1
   NEW_r1=[NEW_r, Reff/R];
   n=length(NEW_r1);
   dr=diff(NEW_r1)*R;
   r=(NEW_r1(1:n-1)*R)+dr/2;
 else
   dr=(Reff-grip)/nbe;
   r=grip:dr:Reff-dr;,r=r+dr/2;
 end
 RbarT=rT2*Rbar;

 betao=asin((T/b*RbarT-(.5*(R-e)+e)*wblade)/((.5*(R-e)+e)^2*omega^2*mblade));

% *** trimming collective ***

 t0=clock;

 k=1;

 error0=(T*.02)+1;

 while abs(error0) > T*.02
   set(H_STATUS2,'String',['ROTOR TRIM ROUTINE IS ON ITERATION # ',num2str(k)])

   set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
   Tpsi=zeros(size(psi));
   Npsi=zeros(size(psi));
   thrcalc

   error0=T-(mean(Tpsi)*b);

   if error0 < -T*.02,

    thetao=thetao-0.35*thetao*abs(1.5*error0/T)*(1-mu);

   elseif error0 > T*.02,

    thetao=thetao+0.35*thetao*abs(1.5*error0/T)*(1-mu);

   end

   theta=thetao+theta1c.*cos(psi)+theta1s.*sin(psi);

   if k > 1,

    if abs(error0) > abs(error1),

      clc
      trim_warning
      set(H_GO,'Enable','off');
      set(H_RES,'Enable','off');
      set(H_RUPT,'Enable','off');
```

```
      set(H_BK,'Enable','on');
      error('*** END OF PROGRAM ***')
    end

   end

   error1=error0;
   k=k+1;
  end

%   *** trimming cyclic ***

  k=1;

  error0=(((T/b)*rT2*(R-grip))*.04)+1;

  while error0 > ((T/b)*rT2*(R-grip))*.04

   set(H_STATUS2,'String',['CYCLIC TRIM ROUTINE IS ON ITERATION # ',num2str(k)])
   set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
   time=etime(clock,t0);

   if time > 15,

     set(H_STATUS,'String','STILL TRIMMING ...')
     set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
     set(H_STATUS2,'String',['CYCLIC TRIM ROUTINE IS ON ITERATION # ',num2str(k)])

     pause(3)
     t0=clock;

   end

   Mpsi(:,k)=zeros(size(psi));

   tmcalc

   theta=[theta theta(:,k)];

   Mpsi=[Mpsi Mpsi(:,k)];
%   *** calculation of initial dthetadM ***

   if k < 2,

    theta(:,k+1)=theta(:,k)+0.25/57.3;

    Mpsi(:,k+1)=zeros(size(psi));

    k=k+1;

    tmcalc

    k=k-1;
```

```
  dthetadM=(theta(:,k+1)-theta(:,k))./(Mpsi(:,k+1)-Mpsi(:,k));

 end

%  *** calculation of M first harmonic parameters ***

 M1c=2*sum(Mpsi(:,k).*cos(psi))/naz;

 M1s=2*sum(Mpsi(:,k).*sin(psi))/naz;

%  *** removal of first harmonic terms from Mpsi ***

 Mpsi(:,k+1)=Mpsi(:,k)-M1c.*cos(psi)-M1s.*sin(psi);

 delM=Mpsi(:,k+1)-Mpsi(:,k);

 error0=max(delM)-min(delM);
 if k > 1,

  if error0 > error1,

    clc
    trim_warning
    set(H_GO,'Enable','off');
    set(H_RES,'Enable','off');
    set(H_RUPT,'Enable','off');
    set(H_BK,'Enable','on');
    error('*** END OF PROGRAM ***')
  end

 end
 error1=error0;

%  *** calculation of new theta ***

 delM=0.5*(1-mu)*delM;

 theta(:,k+1)=theta(:,k)+(dthetadM.*delM);

 if error0 <= ((T/b)*rT2*(R-grip))*.04,

  theta1c=2*sum(theta(:,k).*cos(psi))/naz;

  theta1s=2*sum(theta(:,k).*sin(psi))/naz;

 else

  theta1c=2*sum(theta(:,k+1).*cos(psi))/naz;

  theta1s=2*sum(theta(:,k+1).*sin(psi))/naz;

 end
```

```
   theta(:,k+1)=thetao+theta1c.*cos(psi)+theta1s.*sin(psi);

%  *** calculation of new dthetadM ***

   theta=[theta theta(:,k+1)];

   Mpsi=[Mpsi Mpsi(:,k+1)];

   theta(:,k+2)=theta(:,k)+0.25/57.3;

   Mpsi(:,k+2)=zeros(size(Mpsi(:,k+1)));

   k=k+2;

   tmcalc

   k=k-2;

   dthetadM=(theta(:,k+2)-theta(:,k))./(Mpsi(:,k+2)-Mpsi(:,k));

   k=k+1;
  end

%  *** retrimming collective ***

  theta=theta(:,k);

  k=1;

  error0=(T*.01)+1;

  while abs(error0) > T*.01
   set(H_STATUS2,'String',['COLLECTIVE TRIM ROUTINE IS ON ITERATION # ',num2str(k)])
   set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
   Tpsi=zeros(size(psi));
   Npsi=zeros(size(psi));
   thrcalc

   error0=T-(mean(Tpsi)*b);

    if error0 < -T*.01,

     thetao=thetao-0.25*thetao*abs(1.25*error0/T)*(1-mu);

    elseif error0 > T*.01,

     thetao=thetao+0.25*thetao*abs(1.25*error0/T)*(1-mu);

    end

   theta=thetao+theta1c.*cos(psi)+theta1s.*sin(psi);
```

```
    if k > 1,

     if abs(error0) > abs(error1),

       clc
       trim_warning
       set(H_GO,'Enable','off');
       set(H_RES,'Enable','off');
       set(H_RUPT,'Enable','off');
       set(H_BK,'Enable','on');
       error('*** END OF PROGRAM ***')
     end

    end

    error1=error0;

    k=k+1;

  end

% *** recalculating rotor H force ***

  if Vinf < 16.9,

   Hrotor=0;

   dT=[dT ddT];
   dN=[dN ddN];

   dD=[dD ddD];

  else

   dT=[dT ddT];
   dN=[dN ddN];

   dD=[dD ddD];

    for i=1:length(r)+1,

      H1c(i)=2*sum(dT(:,i).*cos(psi))/naz;

      H1s(i)=2*sum(dD(:,i).*sin(psi))/naz;

    end

   Hrotor=(((b*cos(alphaT)/2)*(sum(H1s)-sin(betao)*sum(H1c)))+Drotor)/2;

  end

% *** recalculating rT ***
```

```
  rT1=rT2;

  rT2=(((mean(Mpsi(:,length(Mpsi(1,:))-1))/mean(Tpsi))/R)+rT1)/2;

end

% *** recalculating drag moments ***

dT=dT(:,1:nbe);
dN=dN(:,1:nbe);
dD=dD(:,1:nbe);

DMpsi=zeros(size(psi));

dmcalc

dT=[dT ddT];
dN=[dN ddN];

dD=[dD ddD];
set(H_STATUS,'String','ROTOR TRIMMED')
set(H_STATUS1,'String',['RUN ELAPSED TIME IS ' num2str(fix(toc)) ' SECONDS'])
set(H_STATUS2,'String','IS THIS BETTER THAN JANRAD 3 OR WHAT?')
pause(3)
set(H_STATUS2,'String','')
save perftemp mchord DMpsi  % Eccles addition - perf.m was

                    % not recognizing mchord and DMpsi.
```

APPENDIX AQ. THRCALC.M

This script M-file is a subroutine of Trim.m to calculate the rotor thrust.

```
% THRCALC.M

% thrcalc calculates the total thrust along a blade at
% each azimuth (psi) location
% JANRAD 98 VERSION 5.0

global MESH_VAL MESH_STA AF_MAIN AF_TIP r_mesh

Up=zeros(size(psi*r));
Ut=zeros(size(Up));
dT=zeros(size(Up));
dN=zeros(size(Up));
ddT=zeros(size(psi));
ddN=zeros(size(psi));

for i=1:length(psi),
 Up(i,:)=vi.*cos(betao)+Vinf*sin(alphaT)*cos(betao)+Vinf*cos(alphaT)*sin(betao)*cos(psi(i));
 Ut(i,:)=r.*omega+Vinf*cos(alphaT)*sin(psi(i));
 phi=atan2(Up(i,:),Ut(i,:));
 alpha=theta(i)+betat-phi;

 % Eccles added the following line for use with Mach dependent afoil files.
 Mach = (Vtip.*cos(alphaT).*r./R+Vinf.*sin(psi(i)))/(49.05*sqrt(temp+460));
  switch MESH_VAL

  case 0
    if afoil==1,
     [CL,CD]=oo12clcd(alpha, Mach);
    elseif afoil==2,
     [CL,CD]=hh02clcd(alpha);
    elseif afoil==3,
     [CL,CD]=vr12clcd(alpha,Mach);
    elseif afoil==4,
     [CL,CD]=vr15clcd(alpha,Mach);
    elseif afoil==5,
     [CL,CD]=sc1094r8clcd(alpha,Mach);
    elseif afoil==6,
     [CL,CD]=sc1095r8clcd(alpha,Mach);
    end

  case 1
    r_mesh=find((r./R)<eval(MESH_STA));

    if AF_MAIN==2,
     [CL_m,CD_m]=oo12clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
```

```
    elseif AF_MAIN==3,
     [CL_m,CD_m]=hh02clcd(alpha(1:max(r_mesh)));
    elseif AF_MAIN==4,
     [CL_m,CD_m]=vr12clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
    elseif AF_MAIN==5,
     [CL_m,CD_m]=vr15clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
    elseif AF_MAIN==6,
     [CL_m,CD_m]=sc1094r8clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
    elseif AF_MAIN==7,
     [CL_m,CD_m]=sc1095r8clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
    end

    if AF_TIP==2,
     [CL_t,CD_t]=oo12clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    elseif AF_TIP==3,
     [CL_t,CD_t]=hh02clcd(alpha(max(r_mesh)+1:nbe));
    elseif AF_TIP==4,
     [CL_t,CD_t]=vr12clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    elseif AF_TIP==5,
     [CL_t,CD_t]=vr15clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    elseif AF_TIP==6,
     [CL_t,CD_t]=sc1094r8clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    elseif AF_TIP==7,
     [CL_t,CD_t]=sc1095r8clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    end
    CL=[CL_m CL_t];
    CD=[CD_m CD_t];
  end
  dT(i,:)=0.5*rho.*cblade.*dr.*(Up(i,:).^2+Ut(i,:).^2).*(CL.*cos(phi)-CD.*sin(phi));
  Tpsi(i)=sum(dT(i,:));
  dN(i,:)=0.5*rho.*cblade.*dr.*(Up(i,:).^2+Ut(i,:).^2).*(CL.*cos(alpha)+CD.*sin(alpha));
  Npsi(i)=sum(dT(i,:));

% *** calculations for tip loss area ***
 Uptip=Vinf*sin(alphaT)*cos(betao)+Vinf*cos(alphaT)*sin(betao)*cos(psi(i));
 Uttip=(R-(R-Reff)/2)*omega+Vinf*cos(alphaT)*sin(psi(i));
 phitip=atan2(Uptip,Uttip);
 alphatip=theta(i)+betat(nbe)-phitip;

 ddT(i)=0.5*rho*cblade(nbe)*(0.5+0.5*cos(2*psi(i)))*(R-Reff)*(Uptip^2+Uttip^2)*(-.009*sin(phitip));
 Tpsi(i)=Tpsi(i)+ddT(i);
 ddN(i)=0.5*rho*cblade(nbe)*(0.5+0.5*cos(2*psi(i)))*(R-Reff)*(Uptip^2+Uttip^2)*(-.009*sin(alphatip));
 Npsi(i)=Npsi(i)+ddN(i);
end
```

APPENDIX AR. TMCALC.M

This script M-file is a subroutine of Trim.m to calculate the rotor thrust moment.

```
% TMCALC.M

% tmcalc calculates the total thrust moment along a blade
% at each azimuth (psi) location
% JANRAD 98 VERSION 5.0

global MESH_VAL MESH_STA AF_MAIN AF_TIP r_mesh

Up=zeros(size(psi*r));
Ut=zeros(size(Up));
dM=zeros(size(Up));
ddM=zeros(size(psi));

for i=1:length(psi),
 Up(i,:)=vi.*cos(betao)+Vinf*sin(alphaT)*cos(betao)+Vinf*cos(alphaT)*sin(betao)*cos(psi(i));
 Ut(i,:)=r.*omega+Vinf*cos(alphaT)*sin(psi(i));
 phi=atan2(Up(i,:),Ut(i,:));
 alpha=theta(i,k)+betat-phi;


 % Eccles added the following line for use with Mach dependent afoil files.
 Mach = (Vtip.*cos(alphaT).*r./R+Vinf.*sin(psi(i)))/(49.05*sqrt(temp+460));

 switch MESH_VAL
  case 0
   if afoil==1,
    [CL,CD]=oo12clcd(alpha, Mach);
   elseif afoil==2,
    [CL,CD]=hh02clcd(alpha);
   elseif afoil==3,
    [CL,CD]=vr12clcd(alpha,Mach);
   elseif afoil==4,
    [CL,CD]=vr15clcd(alpha,Mach);
   elseif afoil==5,
    [CL,CD]=sc1094r8clcd(alpha,Mach);
   elseif afoil==6,
    [CL,CD]=sc1095r8clcd(alpha,Mach);
   end

  case 1
   r_mesh=find((r./R)<eval(MESH_STA));

   if AF_MAIN==2,
    [CL_m,CD_m]=oo12clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
   elseif AF_MAIN==3,
```

```
      [CL_m,CD_m]=hh02clcd(alpha(1:max(r_mesh)));
     elseif AF_MAIN==4,
      [CL_m,CD_m]=vr12clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
     elseif AF_MAIN==5,
      [CL_m,CD_m]=vr15clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
     elseif AF_MAIN==6,
      [CL_m,CD_m]=sc1094r8clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
     elseif AF_MAIN==7,
      [CL_m,CD_m]=sc1095r8clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
     end

     if AF_TIP==2,
      [CL_t,CD_t]=oo12clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
     elseif AF_TIP==3,
      [CL_t,CD_t]=hh02clcd(alpha(max(r_mesh)+1:nbe));
     elseif AF_TIP==4,
      [CL_t,CD_t]=vr12clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
     elseif AF_TIP==5,
      [CL_t,CD_t]=vr15clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
     elseif AF_TIP==6,
      [CL_t,CD_t]=sc1094r8clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
     elseif AF_TIP==7,
      [CL_t,CD_t]=sc1095r8clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
     end
     CL=[CL_m CL_t];
     CD=[CD_m CD_t];
   end
 dM(i,:)=0.5*rho.*cblade.*r.*dr.*(Up(i,:).^2+Ut(i,:).^2).*(CL.*cos(phi)-CD.*sin(phi));
 Mpsi(i,k)=sum(dM(i,:));

% *** calculations for tip loss areas ***
 Uptip=Vinf*sin(alphaT)*cos(betao)+Vinf*cos(alphaT)*sin(betao)*cos(psi(i));
 Uttip=(R-(R-Reff)/2)*omega+Vinf*cos(alphaT)*sin(psi(i));
 phitip=atan2(Uptip,Uttip);

 ddM(i)=0.5*rho*cblade(nbe)*(0.5+0.5*cos(2*psi(i)))*(R-(R-Reff)/2)*(R-Reff)*(Uptip^2+Uttip^2)*(-
.009*sin(phitip));
 Mpsi(i,k)=Mpsi(i,k)+ddM(i);
end
```

APPENDIX AS. DMCALC.M

This script M-file is a subroutine of Trim.m to calculate the rotor drag moment.

```
% DMCALC.M

% dmcalc calculates the total drag along a blade at
% each azimuth (psi) location
% JANRAD 98 VERSION 5.0

global MESH_VAL MESH_STA AF_MAIN AF_TIP r_mesh

Up=zeros(size(psi*r));
Ut=zeros(size(Up));
alpham=zeros(size(Up));
dD=zeros(size(Up));
ddD=zeros(size(psi));
ddDM=zeros(size(psi));
for i=1:length(psi),
 Up(i,:)=vi.*cos(betao)+Vinf*sin(alphaT)*cos(betao)+Vinf*cos(alphaT)*sin(betao)*cos(psi(i));
 Ut(i,:)=r.*omega+Vinf*cos(alphaT)*sin(psi(i));
 phi=atan2(Up(i,:),Ut(i,:));
 alpha=theta(i)+betat-phi;
 alpham(i,:)=alpha;
% Eccles added the following line for use with Mach dependent afoil files.
 Mach = (Vtip.*cos(alphaT).*r./R+Vinf.*sin(psi(i)))/(49.05*sqrt(temp+460));
switch MESH_VAL

  case 0
    if afoil==1,
     [CL,CD]=oo12clcd(alpha, Mach);
    elseif afoil==2,
     [CL,CD]=hh02clcd(alpha);
    elseif afoil==3,
     [CL,CD]=vr12clcd(alpha, Mach);
    elseif afoil==4,
     [CL,CD]=vr15clcd(alpha, Mach);
    elseif afoil==5,
     [CL,CD]=sc1094r8clcd(alpha,Mach);
    elseif afoil==6,
     [CL,CD]=sc1095r8clcd(alpha,Mach);
    end

  case 1
    r_mesh=find((r./R)<eval(MESH_STA));
    if AF_MAIN==2,
     [CL_m,CD_m]=oo12clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
    elseif AF_MAIN==3,
     [CL_m,CD_m]=hh02clcd(alpha(1:max(r_mesh)));
```

```
    elseif AF_MAIN==4,
     [CL_m,CD_m]=vr12clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
    elseif AF_MAIN==5,
     [CL_m,CD_m]=vr15clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
    elseif AF_MAIN==6,
     [CL_m,CD_m]=sc1094r8clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
    elseif AF_MAIN==7,
     [CL_m,CD_m]=sc1095r8clcd(alpha(1:max(r_mesh)), Mach(1:max(r_mesh)));
    end
    if AF_TIP==2,
     [CL_t,CD_t]=oo12clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    elseif AF_TIP==3,
     [CL_t,CD_t]=hh02clcd(alpha(max(r_mesh)+1:nbe));
    elseif AF_TIP==4,
     [CL_t,CD_t]=vr12clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    elseif AF_TIP==5,
     [CL_t,CD_t]=vr15clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    elseif AF_MAIN==6,
     [CL_t,CD_t]=sc1094r8clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    elseif AF_TIP==7,
     [CL_t,CD_t]=sc1095r8clcd(alpha(max(r_mesh)+1:nbe), Mach(max(r_mesh)+1:nbe));
    end
    CL=[CL_m CL_t];
    CD=[CD_m CD_t];
  end
 dD(i,:)=0.5*rho*cblade.*dr.*(Up(i,:).^2+Ut(i,:).^2).*(CL.*sin(phi)+CD.*cos(phi));
 dDM=dD(i,:).*r;
 DMpsi(i)=sum(dDM);

% *** calculations for tip loss area ***
 Uptip=Vinf*sin(alphaT)*cos(betao)+Vinf*cos(alphaT)*sin(betao)*cos(psi(i));
 Uttip=(R-(R-Reff)/2)*omega+Vinf*cos(alphaT)*sin(psi(i));
 phitip=atan2(Uptip,Uttip);

 ddD(i)=0.5*rho*cblade(nbe)*(0.5+0.5*cos(2*psi(i)))*(R-Reff)*(Uptip^2+Uttip^2)*(.009*cos(phitip));
 ddDM(i)=ddD(i)*(R-(R-Reff)/2);
 DMpsi(i)=DMpsi(i)+ddDM(i);
end
```

APPENDIX AT. 0012CLCD.M

This MATLAB function calculates a c_l and c_d for a NACA 0012 airfoil given angle of attack and Mach number. It is called in Thrcalc.m, Tmcalc.m and Dmcalc.m script M-files.

```
% oo12clcd calculates CL and CD for the NACA 0012
% airfoil given angle of attack in radians and the
% local Mach number:
%
% [CL,CD]=oo12clcd(alpha, Mach)
%
% Both 'alpha' and 'Mach' are intended to be vectors
% the elements of which correspond to the rotor blade
% radial stations of interest in a blade element analysis.
% All equations are based on Ray Prouty's treatment of
% the 0012 in his text.

% JANRAD 98 VERSION 5.0

function [CL,CD]=oo12clcd(alpha, Mach)
CL=zeros(size(alpha));
CD=zeros(size(alpha));
a=alpha*180/pi;
aL = 15 - 16.*Mach;
aD = 17 - 23.4.*Mach;
K1 = 0.0233 + 0.342.*(Mach.^7.15);
K2 = 2.05 - 0.95.*Mach;


% CL for Mach numbers < 0.725 and AOA inside +/- 20 deg:

chk=(Mach<0.725 & a>=0 & a<=aL);
 CL=CL+chk.*((0.1./sqrt(1-Mach.^2) - 0.01.*Mach).*a);

chk=(Mach<0.725 & a>aL & a<=20);
 CL=CL+chk.*((0.1./sqrt(1-Mach.^2) - 0.01.*Mach).*a - K1.*(a-aL).^K2);

chk=(Mach<0.725 & a>=-20 & a<-aL);
 CL=CL-chk.*((0.1./sqrt(1-Mach.^2) - 0.01.*Mach).*abs(a) - K1.*(abs(a)-aL).^K2);

chk=(Mach<0.725 & a>=-aL & a<0);
 CL=CL-chk.*((0.1./sqrt(1-Mach.^2) - 0.01.*Mach).*abs(a));


% CL for Mach numbers > 0.725 and AOA inside +/- 20 deg:
```

```
chk=(Mach>=0.725 & a>=0 & a<=aL);
 CL=CL+chk.*((0.677 - 0.744.*Mach).*a);

chk=(Mach>=0.725 & a>aL & a<=20);
 CL=CL+chk.*((0.677 - 0.744.*Mach).*a - (0.0575-0.144.*(Mach-0.725).^0.44).*(a-aL).^(K2));

chk=(Mach>=0.725 & a<0 & a>=-aL);
 CL=CL-chk.*((0.677 - 0.744.*Mach).*abs(a));

chk=(Mach>=0.725 & a<-aL & a>=-20);
 CL=CL-chk.*((0.677 - 0.744.*Mach).*abs(a) - (0.0575-0.144.*(Mach-0.725).^0.44).*(abs(a)-aL).^(K2));


% CL for all Mach numbers and AOA outside +/- 20deg:

chk=(a>20 & a<=161);
 CL=CL+chk.*(1.15.*sin(2.*alpha));

chk=(a>161 & a<=173);
 CL=CL+chk.*(-0.7);

chk=(a>173 & a<=180);
 CL=CL+chk.*(0.1.*(a-180));

chk=(a>=-180 & a<=-173);
 CL=CL+chk.*(0.1.*(a+180));

chk=(a>-173 & a<=-161);
 CL=CL+chk.*(0.7);

chk=(a>-161 & a<-20);
 CL=CL+chk.*(1.15.*sin(2.*alpha));



% CD for Mach numbers < 0.725 and AOA inside +/- 20 deg:

chk=(Mach<0.725 & a>=0 & a<=aD);
 CD=CD+chk.*(0.0081 + (-350.*a + 396.*a.^2 - 63.3.*a.^3 + 3.66.*a.^4).*10.^(-6));

chk=(Mach<0.725 & a>aD & a<=20);
 CD=CD+chk.*((0.0081 + (-350.*a + 396.*a.^2 - 63.3.*a.^3 + 3.66.*a.^4).*10.^(-6)) + 0.00066.*(a-
aD).^2.54);

chk=(Mach<0.725 & a<0 & a>=-aD);
 CD=CD+chk.*(0.0081 + (-350.*abs(a) + 396.*a.^2 - 63.3.*abs(a).^3 + 3.66.*a.^4).*10.^(-6));

chk=(Mach<0.725 & a<-aD & a>=-20);
 CD=CD+chk.*((0.0081 + (-350.*abs(a) + 396.*a.^2 - 63.3.*abs(a).^3 + 3.66.*a.^4).*10.^(-6)) +
0.00066.*(abs(a)-aD).^2.54);
```

```
% CD for Mach numbers > 0.725 and AOA inside +/- 20 deg:

chk=(Mach>=0.725 & a>=0 & a<=20);
 CD=CD+chk.*((0.0081 + (-350.*a + 396.*a.^2 - 63.3.*a.^3 + 3.66.*a.^4).*10.^(-6)) + 0.00035.*a.^2.54 +
21.*(Mach-0.725).^3.2);

chk=(Mach>=0.725 & a<0 & a>=-20);
 CD=CD+chk.*((0.0081 + (-350.*abs(a) + 396.*a.^2 - 63.3.*abs(a).^3 + 3.66.*a.^4).*10.^(-6)) +
0.00035.*abs(a).^2.54 + 21.*(Mach-0.725).^3.2);


% CD for all Mach numbers and AOA outside +/- 20deg:

chk=(a>20 & a<=180);
 CD=CD+chk.*(1.03 - 1.02.*cos(2.*alpha));

chk=(a>=-180 & a<-20);
 CD=CD+chk.*(1.03 - 1.02.*cos(2.*alpha));
```

APPENDIX AU. HH02CLCD.M

This MATLAB function calculates a c_l and c_d for an HH-02 airfoil given angle of attack. It is called in Thrcalc.m, Tmcalc.m and Dmcalc.m script M-files.

```
function [CL,CD]=hh02clcd(alpha)

%  hh02clcd calculates CL and CD for an HH-02 airfoil
%  given angle of attack (alpha) in radians
%  [CL,CD]=hh02clcd(alpha)
%  JANRAD 98 VERSION 5.0

CL=zeros(size(alpha));
CD=zeros(size(alpha));
a=alpha*180/pi;

chk1=(a>=20 & a<=180);
 CL=CL+chk1.*(0.42541+0.026863*a+5.5988e-4*a.^2-2.1493e-5*a.^3+1.5932e-7*a.^4-3.4659e-10*a.^5);
 CD=CD+chk1.*(-0.7179+0.061213*a-5.9861e-4*a.^2+7.3708e-6*a.^3-6.6605e-8*a.^4+1.913e-10*a.^5);

chk1=(a>=-180 & a<=-50);
 CL=CL+chk1.*(-4.6183-0.1923*a-3.5554e-3*a.^2-3.3273e-5*a.^3-1.4528e-7*a.^4-2.3003e-10*a.^5);
 CD=CD+chk1.*(2.7093e-2-2.1309e-2*a+2.0335e-4*a.^2+3.47e-7*a.^3-3.0586e-8*a.^4-1.2584e-10*a.^5);

chk1=(a>-50 & a<-20);
 CL=CL+chk1.*(-2.5519-0.22847*a-9.5667e-3*a.^2-1.7051e-4*a.^3-1.0909e-6*a.^4);
 CD=CD+chk1.*(2.7093e-2-2.1309e-2*a+2.0335e-4*a.^2+3.47e-7*a.^3-3.0586e-8*a.^4-1.2584e-10*a.^5);

chk1=(a>=-20 & a<=-10);
 CL=CL+chk1.*(-0.2+0.089*a+0.0034*a.^2);
 CD=CD+chk1.*(2.7093e-2-2.1309e-2*a+2.0335e-4*a.^2+3.47e-7*a.^3-3.0586e-8*a.^4-1.2584e-10*a.^5);

chk1=(a<20 & a>-10);
  CL=CL+chk1.*(5.8766e-2+1.3131e-1*a+2.4742e-3*a.^2-5.303e-4*a.^3-1.5818e-5*a.^4+1.28e-6*a.^5);
  chk2=a<-4;
  chk2=chk2.*chk1;
   CD=CD+chk2.*(1.3786+0.916*a+0.21396*a.^2+2.0371e-2*a.^3+7.0076e-4*a.^4);
  chk2=(a>=-4 & a<=7);
   chk2=chk2.*chk1;
```

```
CD=CD+chk2.*(9.732e-3+3.2326e-4*a+1.4392e-4*a.^2-8.5073e-5*a.^3+1.1826e-6*a.^4+1.5271e-
6*a.^5);
 chk2=a>7;
 chk2=chk2.*chk1;
  CD=CD+chk2.*(1.842e-1-5.7532e-2*a+5.8043e-3*a.^2-1.2803e-4*a.^3);
```

APPENDIX AV. AIRSPEED_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the airspeed iteration method.

```
function airspeed_iteration_plots()

%  Plot Routine For Airspeed Iteration.
%  JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load airspeed_iteration_plots

global PICK H_AS_IT...
H_AS_IT_P1 H_AS_IT_P2 H_AS_IT_P3 H_AS_IT_P4 H_AS_IT_P5...
H_AS_IT_P6 H_AS_IT_P7 H_AS_IT_P8 H_AS_IT_P9 H_AS_IT_P10

H_AS_IT = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Airspeed Iteration Plots', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
  'Position',[0.170898 0.0963542 0.65625 0.824219], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_AS_IT, ...
    'Units','normalized', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
  'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.173363 0.872038 0.659226 0.101106], ...
    'String','Plot Selection For Airspeed Iteration', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_AS_IT, ...
    'Units','normalized', ...
    'FontSize',12, ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.21875 0.707741 0.568452 0.0647709], ...
    'String','Check The Boxes Below For Desired Plots', ...
    'Style','text', ...
    'Tag','StaticText2');
H_AS_IT_P1 = uicontrol('Parent',H_AS_IT, ...
    'Units','normalized', ...
```

```
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.150298 0.603476 0.705357 0.0458136], ...
    'String','Main Rotor Plots- Speed vs T/RHP/TPPangle/Liftpercent',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_AS_IT_P2 = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.151786 0.545901 0.702381 0.0473934], ...
    'String','Rotor/Tail Rotor/Total Power Required',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_AS_IT_P3 = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.150298 0.489907 0.705357 0.0458136], ...
    'String','Rotor Speed vs Airspeed (Constant Tip Speed)',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_AS_IT_P4 = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.151786 0.432333 0.702381 0.0473934], ...
    'String','Auxiliary Thrust vs Airspeed',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_AS_IT_P5 = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.150298 0.376338 0.705357 0.0458136], ...
    'String','Coeff of Power vs Coeff of Thrust at Max Airspeed',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_AS_IT_P6 = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.151786 0.318764 0.702381 0.0473934], ...
    'String','Coeff of Thrust vs Figure of Merit',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_AS_IT_P7 = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.150298 0.26277 0.705357 0.0458136], ...
    'String','Drag vs Airspeed',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_AS_IT_P8 = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.151786 0.205196 0.702381 0.0473934], ...
    'String','Required Collective Pitch vs Airspeed',...
    'Style','checkbox', ...
```

```
        'Tag','Checkbox1');
H_AS_IT_P9 = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.150298 0.149201 0.705357 0.0458136], ...
    'String','1st Lateral Cyclic Term (a1s) vs Airspeed',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_AS_IT_P10 = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.151786 0.0916272 0.702381 0.0473934], ...
    'String','1st Longitudinal Cyclic Term (b1s) vs Airspeed',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
b = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
    'Callback','create_plots_fcn plots', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.589286 0.01 0.235119 0.0677165], ...
        'String','Create Plots', ...
        'Tag','Pushbutton1');
b = uicontrol('Parent',H_AS_IT, ...
        'Units','normalized', ...
        'Callback','out_count=1;create_plots_fcn back', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.178571 0.01 0.235119 0.0677165], ...
        'String','<< Back', ...
        'Tag','Pushbutton1');

assignin('base','H_AS_IT_P1',H_AS_IT_P1)
assignin('base','H_AS_IT_P2',H_AS_IT_P2)
assignin('base','H_AS_IT_P3',H_AS_IT_P3)
assignin('base','H_AS_IT_P4',H_AS_IT_P4)
assignin('base','H_AS_IT_P5',H_AS_IT_P5)
assignin('base','H_AS_IT_P6',H_AS_IT_P6)
assignin('base','H_AS_IT_P7',H_AS_IT_P7)
assignin('base','H_AS_IT_P8',H_AS_IT_P8)
assignin('base','H_AS_IT_P9',H_AS_IT_P9)
assignin('base','H_AS_IT_P10',H_AS_IT_P10)
```

APPENDIX AW. ALTITUDE_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the altitude iteration method.

```
function altitude_iteration_plots()

%   Plot Routine For Altitude Iteration.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load altitude_iteration_plots

global H_AL_IT H_AL_IT_P1 H_AL_IT_P2 H_AL_IT_P3 H_AL_IT_P4 H_AL_IT_P5

H_AL_IT = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Altitude Iteration Plots', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.169922 0.0976562 0.65625 0.824219], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_AL_IT, ...
    'Units','normalized', ...
  'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.173363 0.872038 0.659226 0.101106], ...
    'String','Plot Selection For Altitude Iteration', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_AL_IT, ...
    'Units','normalized', ...
  'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.21875 0.707741 0.568452 0.0647709], ...
    'String','Check The Boxes Below For Desired Plots', ...
    'Style','text', ...
    'Tag','StaticText2');
H_AL_IT_P1 = uicontrol('Parent',H_AL_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.14881 0.603476 0.705357 0.0458136], ...
```

```
        'String','Total Power Required vs Altitude', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
H_AL_IT_P2 = uicontrol('Parent',H_AL_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.14881 0.545901 0.702381 0.0473934], ...
        'String','Rotor Drag vs Altitude', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
H_AL_IT_P3 = uicontrol('Parent',H_AL_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.14881 0.489731 0.705357 0.0458136], ...
        'String','Required Collective Pitch vs Altitude', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
H_AL_IT_P4 = uicontrol('Parent',H_AL_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.14881 0.42654 0.705357 0.0458136], ...
        'String','1st Lateral Cyclic Term vs Altitude', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
H_AL_IT_P5 = uicontrol('Parent',H_AL_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.14881 0.363349 0.705357 0.0458136], ...
        'String','1st Longitudinal Cyclic Term vs Altitude', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
H_AL_IT_P6 = uicontrol('Parent',H_AL_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.14881 0.300158 0.705357 0.0458136], ...
        'String','Blank', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
H_AL_IT_P7 = uicontrol('Parent',H_AL_IT, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.14881 0.232227 0.705357 0.0458136], ...
        'String','Blank', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
b = uicontrol('Parent',H_AL_IT, ...
        'Units','normalized', ...
        'Callback','create_plots_fcn plots', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.589286 0.01 0.235119 0.0677165], ...
        'String','Create Plots', ...
```

```
    'Tag','Pushbutton1');
b = uicontrol('Parent',H_AL_IT, ...
    'Units','normalized', ...
    'Callback','out_count=1;create_plots_fcn back', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.178571 0.01 0.235119 0.0677165], ...
    'String','<< Back', ...
    'Tag','Pushbutton1');
```

APPENDIX AX. GROSSWEIGHT_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the altitude iteration method.

```
function grosswt_iteration_plots()

% Plot Routine For Gross Weight Iteration.
% JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load grosswt_iteration_plots

global H_GW_IT H_GW_IT_P1 H_GW_IT_P2 H_GW_IT_P3 H_GW_IT_P4 H_GW_IT_P5...
    H_GW_IT_P6 H_GW_IT_P7 H_GW_IT_P8 H_GW_IT_P9

H_GW_IT = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Gross Weight Iteration Plots', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.170898 0.0963542 0.65625 0.824219], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.173363 0.872038 0.659226 0.101106], ...
    'String','Plot Selection For Gross Weight Iteration', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'FontSize',12, ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.21875 0.707741 0.568452 0.0647709], ...
    'String','Check The Boxes Below For Desired Plots', ...
    'Style','text', ...
    'Tag','StaticText2');
H_GW_IT_P1 = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
  'Position',[0.150298 0.603476 0.705357 0.0458136], ...
    'String','Total Power Required vs Gross Weight (No HIGE Calculations)',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_GW_IT_P2 = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.545901 0.702381 0.0473934], ...
  'String','Rotor Drag vs Gross Weight',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_GW_IT_P3 = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.489907 0.705357 0.0458136], ...
  'String','Required Collective Pitch vs Gross Weight',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_GW_IT_P4 = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.432333 0.702381 0.0473934], ...
  'String','1st Lateral Cyclic Term vs Gross Weight',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_GW_IT_P5 = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.376338 0.705357 0.0458136], ...
  'String','1st Longitudinal Cyclic Term vs Gross Weight',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_GW_IT_P6 = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.318764 0.702381 0.0473934], ...
  'String','Coefficient of Thrust vs Gross Weight',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_GW_IT_P7 = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.26277 0.705357 0.0458136], ...
  'String','Coefficient of Power vs Gross Weight',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_GW_IT_P8 = uicontrol('Parent',H_GW_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.205196 0.702381 0.0473934], ...
  'String','Figure of Merit vs Gross Weight',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
```

```
H_GW_IT_P9 = uicontrol('Parent',H_GW_IT, ...
	'Units','normalized', ...
	'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.149201 0.705357 0.0458136], ...
  'String','HIGE Power Required vs Gross Weight (Only if HIGE Calcs Were Completed)',...
  'Style','checkbox', ...
	'Tag','Checkbox1');
b = uicontrol('Parent',H_GW_IT, ...
	'Units','normalized', ...
  'Callback','create_plots_fcn plots', ...
	'FontSize',12, ...
	'FontWeight','bold', ...
	'Position',[0.589286 0.01 0.235119 0.0677165], ...
	'String','Create Plots', ...
	'Tag','Pushbutton1');
b = uicontrol('Parent',H_GW_IT, ...
	'Units','normalized', ...
	'Callback','out_count=1;create_plots_fcn back', ...
	'FontSize',12, ...
	'FontWeight','bold', ...
	'Position',[0.178571 0.01 0.235119 0.0677165], ...
	'String','<< Back', ...
	'Tag','Pushbutton1');
```

APPENDIX AY. BLADETAPERRATIO_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the blade taper ratio iteration method.

```
function bladetaperratio_iteration_plots()

% Plot Routine For Blade Taper Ratio Iteration.
% JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load bladetaperratio_iteration_plots

global H_BTR_IT H_BTR_IT_P1 H_BTR_IT_P2 H_BTR_IT_P3 H_BTR_IT_P4 H_BTR_IT_P5...
    H_BTR_IT_P6 H_BTR_IT_P7 H_BTR_IT_P8

H_BTR_IT = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Blade Taper Ratio Iteration Plots', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.170898 0.0963542 0.65625 0.824219], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_BTR_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.847059 0.752941 0.627451], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.173363 0.872038 0.659226 0.101106], ...
    'String','Plot Selection For Blade Taper Ratio Iteration', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_BTR_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.847059 0.752941 0.627451], ...
    'FontSize',12, ...
    'Position',[0.21875 0.707741 0.568452 0.0647709], ...
    'String','Check The Boxes Below For Desired Plots', ...
    'Style','text', ...
    'Tag','StaticText2');
H_BTR_IT_P1 = uicontrol('Parent',H_BTR_IT, ...
    'Units','normalized', ...
    'Position',[0.150298 0.603476 0.705357 0.0458136], ...
```

```
        'String','Total Power Required vs Blade Taper Ratio',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BTR_IT_P2 = uicontrol('Parent',H_BTR_IT, ...
        'Units','normalized', ...
        'Position',[0.151786 0.545901 0.702381 0.0473934], ...
    'String','Rotor Drag vs Blade Taper Ratio',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BTR_IT_P3 = uicontrol('Parent',H_BTR_IT, ...
        'Units','normalized', ...
        'Position',[0.150298 0.489907 0.705357 0.0458136], ...
    'String','Required Collective Pitch vs Blade Taper Ratio',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BTR_IT_P4 = uicontrol('Parent',H_BTR_IT, ...
        'Units','normalized', ...
        'Position',[0.151786 0.432333 0.702381 0.0473934], ...
    'String','1st Lateral Cyclic Term vs Blade Taper Ratio',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BTR_IT_P5 = uicontrol('Parent',H_BTR_IT, ...
        'Units','normalized', ...
        'Position',[0.150298 0.376338 0.705357 0.0458136], ...
    'String','1st Longitudinal Cyclic Term vs Blade Taper Ratio',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BTR_IT_P6 = uicontrol('Parent',H_BTR_IT, ...
        'Units','normalized', ...
        'Position',[0.151786 0.318764 0.702381 0.0473934], ...
    'String','Coefficient of Thrust vs Blade Taper Ratio',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BTR_IT_P7 = uicontrol('Parent',H_BTR_IT, ...
        'Units','normalized', ...
        'Position',[0.150298 0.26277 0.705357 0.0458136], ...
    'String','Coefficient of Power vs Blade Taper Ratio',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BTR_IT_P8 = uicontrol('Parent',H_BTR_IT, ...
        'Units','normalized', ...
        'Position',[0.151786 0.205196 0.702381 0.0473934], ...
    'String','Figure of Merit vs Blade Taper Ratio',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
b = uicontrol('Parent',H_BTR_IT, ...
        'Units','normalized', ...
    'Callback','create_plots_fcn plots', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.589286 0.01 0.235119 0.0677165], ...
        'String','Create Plots', ...
        'Tag','Pushbutton1');
```

```
b = uicontrol('Parent',H_BTR_IT, ...
    'Units','normalized', ...
    'Callback','out_count=1;create_plots_fcn back', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.178571 0.01 0.235119 0.0677165], ...
    'String','<< Back', ...
    'Tag','Pushbutton1');
```

APPENDIX AZ. NO_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the no iteration method.

```
function no_iteration_plots()

%   Plot Routine For No Iteration.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load no_iteration_plots


global H_NO_IT S_PERF_INPUT S_MATR_VEC plot_val H_NO_IT_P1 H_NO_IT_P2 H_NO_IT_P3...
    H_NO_IT_P4 filename3 out_count PLOT_VALS H_r_VEC r_vec

H_NO_IT = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
  'Name','No Iteration Plots', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.169922 0.0976562 0.65625 0.825521], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.173363 0.872038 0.659226 0.101106], ...
    'String','   Plot Selection For Single Run      (No Iteration)', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'FontSize',12, ...
    'Position',[0.21875 0.707741 0.568452 0.0647709], ...
    'String','Check The Boxes Below For Desired Plots', ...
    'Style','text', ...
    'Tag','StaticText2');
H_NO_IT_P1 = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'Position',[0.13244 0.609449 0.732143 0.0456693], ...
    'String','2-D Thrust vs. r/R  (plotted at psi = 0,90,180,270 deg)', ...
```

```
    'Style','checkbox', ...
    'Tag','Checkbox1');
H_NO_IT_P2 = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'Position',[0.13244 0.551181 0.732143 0.0472441], ...
    'String','3-D Thrust vs. r/R Mesh', ...
    'Style','checkbox', ...
    'Tag','Checkbox1');
H_NO_IT_P3 = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'Position',[0.136905 0.489907 0.705357 0.0458136], ...
    'String','Thrust vs. Psi At Fixed r/R Values (User will input r/R values)', ...
    'Style','checkbox', ...
    'Tag','Checkbox1');
b = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'Position',[0.136905 0.404724 0.100833 0.0708661], ...
    'String','r/R =', ...
    'Style','text', ...
    'Tag','StaticText3');
H_r_VEC = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'Position',[0.258479 0.354331 0.60306 0.12126], ...
    'String','', ...
    'Style','text', ...
    'Tag','StaticText4');
b = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'Position',[0.136905 0.267717 0.275298 0.0598425], ...
    'String','Enter desired r/R values in matrix form (ie. [.7,.8])', ...
    'Style','text', ...
    'Tag','StaticText5');
b = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Position',[0.418155 0.270866 0.428571 0.0566929], ...
    'String','[ ]', ...
  'Callback','global PLOT_VALS, PLOT_VALS=str2num(get(gcbo,"String"));',...
  'Style','edit', ...
    'Tag','EditText1');
H_NO_IT_P4 = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'Position',[0.133929 0.177953 0.735119 0.0472441], ...
    'String','2-D Normal Force (Lift) vs. r/R  (plotted at psi = 0,90,180,270 deg)', ...
    'Style','checkbox', ...
    'Tag','Checkbox1');
b = uicontrol('Parent',H_NO_IT, ...
    'Units','normalized', ...
    'Position',[0.13244 0.11811 0.735119 0.0456693], ...
    'String','Blank', ...
    'Style','checkbox', ...
    'Tag','Checkbox1');
b = uicontrol('Parent',H_NO_IT, ...
```

```
        'Units','normalized', ...
    'Callback','create_plots_fcn plots', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.583333 0.0188976 0.235119 0.0677165], ...
        'String','Create Plots', ...
        'Tag','Pushbutton1');
b = uicontrol('Parent',H_NO_IT, ...
        'Units','normalized', ...
        'Callback','out_count=1;create_plots_fcn back', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.184524 0.0204724 0.235119 0.0677165], ...
        'String','<< Back', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',H_NO_IT, ...
        'Units','normalized', ...
        'Position',[0.13244 0.248819 0.733631 0.292913], ...
        'Style','frame', ...
        'Tag','Frame1');

assignin('base','r_vec',r_vec)
```

APPENDIX BA. BLADETWIST_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the blade twist iteration method.

```
function bladetwist_iteration_plots()

%  Plot Routine For Blade Twist Iteration.
%  JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.


load bladetwist_iteration_plots

global H_BT_IT H_BT_IT_P1 H_BT_IT_P2 H_BT_IT_P3 H_BT_IT_P4 H_BT_IT_P5...
    H_BT_IT_P6 H_BT_IT_P7 H_BT_IT_P8

H_BT_IT = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Blade Twist Iteration Plots', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.170898 0.0963542 0.65625 0.824219], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_BT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.847059 0.752941 0.627451], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.173363 0.872038 0.659226 0.101106], ...
    'String','Plot Selection For Blade Twist Iteration', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_BT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.847059 0.752941 0.627451], ...
    'FontSize',12, ...
    'Position',[0.21875 0.707741 0.568452 0.0647709], ...
    'String','Check The Boxes Below For Desired Plots', ...
    'Style','text', ...
    'Tag','StaticText2');
H_BT_IT_P1 = uicontrol('Parent',H_BT_IT, ...
```

```
        'Units','normalized', ...
        'Position',[0.150298 0.603476 0.705357 0.0458136], ...
        'String','Total Power Required vs Blade Twist',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BT_IT_P2 = uicontrol('Parent',H_BT_IT, ...
        'Units','normalized', ...
        'Position',[0.151786 0.545901 0.702381 0.0473934], ...
    'String','Rotor Drag vs Blade Twist',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BT_IT_P3 = uicontrol('Parent',H_BT_IT, ...
        'Units','normalized', ...
        'Position',[0.150298 0.489907 0.705357 0.0458136], ...
    'String','Required Collective Pitch vs Blade Twist',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BT_IT_P4 = uicontrol('Parent',H_BT_IT, ...
        'Units','normalized', ...
        'Position',[0.151786 0.432333 0.702381 0.0473934], ...
    'String','1st Lateral Cyclic Term vs Blade Twist',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BT_IT_P5 = uicontrol('Parent',H_BT_IT, ...
        'Units','normalized', ...
        'Position',[0.150298 0.376338 0.705357 0.0458136], ...
    'String','1st Longitudinal Cyclic Term vs Blade Twist',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BT_IT_P6 = uicontrol('Parent',H_BT_IT, ...
        'Units','normalized', ...
        'Position',[0.151786 0.318764 0.702381 0.0473934], ...
    'String','Coefficient of Thrust vs Blade Twist',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BT_IT_P7 = uicontrol('Parent',H_BT_IT, ...
        'Units','normalized', ...
        'Position',[0.150298 0.26277 0.705357 0.0458136], ...
    'String','Coefficient of Power vs Blade Twist',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
H_BT_IT_P8 = uicontrol('Parent',H_BT_IT, ...
        'Units','normalized', ...
        'Position',[0.151786 0.205196 0.702381 0.0473934], ...
    'String','Figure of Merit vs Blade Twist',...
    'Style','checkbox', ...
        'Tag','Checkbox1');
b = uicontrol('Parent',H_BT_IT, ...
        'Units','normalized', ...
    'Callback','create_plots_fcn plots', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.589286 0.01 0.235119 0.0677165], ...
```

```
    'String','Create Plots', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',H_BT_IT, ...
    'Units','normalized', ...
    'Callback','out_count=1;create_plots_fcn back', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.178571 0.01 0.235119 0.0677165], ...
    'String','<< Back', ...
    'Tag','Pushbutton1');
```

APPENDIX BB. ROTORRAD_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the rotor radius iteration method.

```
function rotorrad_iteration_plots()

%   Plot Routine For Rotor Radius Iteration.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load rotorrad_iteration_plots

global H_RBR_IT H_RBR_IT_P1 H_RBR_IT_P2 H_RBR_IT_P3 H_RBR_IT_P4 H_RBR_IT_P5...
  H_RBR_IT_P6

H_RBR_IT = figure('Units','normalized', ...
     'Color',[0.8 0.8 0.8], ...
     'Colormap',mat0, ...
     'Name','Main Rotor Blade Radius Iteration Plots', ...
     'NumberTitle','off', ...
     'PointerShapeCData',mat1, ...
     'Position',[0.170898 0.0963542 0.65625 0.824219], ...
     'Tag','Fig1');
b = uicontrol('Parent',H_RBR_IT, ...
     'Units','normalized', ...
     'FontSize',14, ...
     'FontWeight','bold', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.173363 0.872038 0.659226 0.101106], ...
     'String','Plot Selection For Rotor Blade Radius Iteration', ...
     'Style','text', ...
     'Tag','StaticText1');
b = uicontrol('Parent',H_RBR_IT, ...
     'Units','normalized', ...
     'FontSize',12, ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.21875 0.707741 0.568452 0.0647709], ...
     'String','Check The Boxes Below For Desired Plots', ...
     'Style','text', ...
     'Tag','StaticText2');
H_RBR_IT_P1 = uicontrol('Parent',H_RBR_IT, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
 'Position',[0.150298 0.603476 0.705357 0.0458136], ...
   'String','Rotor, Tail and Total Power Required vs Blade Radius',...
 'Style','checkbox', ...
   'Tag','Checkbox1');
H_RBR_IT_P2 = uicontrol('Parent',H_RBR_IT, ...
    'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
 'Position',[0.151786 0.545901 0.702381 0.0473934], ...
 'String','Aux Thrust and Drag vs Blade Radius',...
 'Style','checkbox', ...
   'Tag','Checkbox1');
H_RBR_IT_P3 = uicontrol('Parent',H_RBR_IT, ...
    'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
 'Position',[0.150298 0.489907 0.705357 0.0458136], ...
 'String','Required Collective Pitch vs Blade Radius',...
 'Style','checkbox', ...
   'Tag','Checkbox1');
H_RBR_IT_P4 = uicontrol('Parent',H_RBR_IT, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
 'Position',[0.151786 0.432333 0.702381 0.0473934], ...
 'String','Tail Rotor Power Required vs Blade Radius',...
 'Style','checkbox', ...
   'Tag','Checkbox1');
H_RBR_IT_P5 = uicontrol('Parent',H_RBR_IT, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
 'Position',[0.150298 0.376338 0.705357 0.0458136], ...
 'String','Figure of Merit vs Blade Radius',...
 'Style','checkbox', ...
   'Tag','Checkbox1');
H_RBR_IT_P6 = uicontrol('Parent',H_RBR_IT, ...
   'Units','normalized', ...
   'BackgroundColor',[0.752941 0.752941 0.752941], ...
 'Position',[0.151786 0.318764 0.702381 0.0473934], ...
 'String','Disk Loading vs Blade Radius',...
 'Style','checkbox', ...
   'Tag','Checkbox1');
b = uicontrol('Parent',H_RBR_IT, ...
   'Units','normalized', ...
 'Callback','create_plots_fcn plots', ...
   'FontSize',12, ...
   'FontWeight','bold', ...
   'Position',[0.589286 0.01 0.235119 0.0677165], ...
   'String','Create Plots', ...
   'Tag','Pushbutton1');
b = uicontrol('Parent',H_RBR_IT, ...
   'Units','normalized', ...
   'Callback','out_count=1;create_plots_fcn back', ...
   'FontSize',12, ...
   'FontWeight','bold', ...
   'Position',[0.178571 0.01 0.235119 0.0677165], ...
```

```
'String','<< Back', ...
'Tag','Pushbutton1');
```

APPENDIX BC. ROTORSPD_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the rotor speed iteration method.

```
function rotorspd_iteration_plots()

%   Plot Routine For Rotor Speed Iteration.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load rotorspd_iteration_plots

global H_RBS_IT H_RBS_IT_P1 H_RBS_IT_P2 H_RBS_IT_P3 H_RBS_IT_P4 H_RBS_IT_P5

H_RBS_IT = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Main Rotor Blade Speed Iteration Plots', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.170898 0.0963542 0.65625 0.824219], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_RBS_IT, ...
    'Units','normalized', ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.173363 0.872038 0.659226 0.101106], ...
    'String','Plot Selection For Rotor Blade Speed Iteration', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_RBS_IT, ...
    'Units','normalized', ...
    'FontSize',12, ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.21875 0.707741 0.568452 0.0647709], ...
    'String','Check The Boxes Below For Desired Plots', ...
    'Style','text', ...
    'Tag','StaticText2');
H_RBS_IT_P1 = uicontrol('Parent',H_RBS_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.603476 0.705357 0.0458136], ...
```

```
    'String','Rotor, Tail and Total Power Required vs Blade Speed',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_RBS_IT_P2 = uicontrol('Parent',H_RBS_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.545901 0.702381 0.0473934], ...
  'String','Aux Thrust and Drag vs Blade Speed',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_RBS_IT_P3 = uicontrol('Parent',H_RBS_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.489907 0.705357 0.0458136], ...
  'String','Required Collective Pitch vs Blade Speed',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_RBS_IT_P4 = uicontrol('Parent',H_RBS_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.432333 0.702381 0.0473934], ...
  'String','Tail Rotor Power Required vs Blade Speed',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_RBS_IT_P5 = uicontrol('Parent',H_RBS_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.376338 0.705357 0.0458136], ...
  'String','Disk Loading vs Blade Speed',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
b = uicontrol('Parent',H_RBS_IT, ...
    'Units','normalized', ...
  'Callback','create_plots_fcn plots', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.589286 0.01 0.235119 0.0677165], ...
    'String','Create Plots', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',H_RBS_IT, ...
    'Units','normalized', ...
    'Callback','out_count=1;create_plots_fcn back', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.178571 0.01 0.235119 0.0677165], ...
    'String','<< Back', ...
    'Tag','Pushbutton1');
```

APPENDIX BD. STARTOFTAPER_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the start of taper iteration method.

```
function startoftaper_iteration_plots()

%   Plot Routine For Start of Taper Iteration.
%   JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load startoftaper_iteration_plots

global H_SOT_IT H_SOT_IT_P1 H_SOT_IT_P2 H_SOT_IT_P3 H_SOT_IT_P4 H_SOT_IT_P5...
    H_SOT_IT_P6 H_SOT_IT_P7 H_SOT_IT_P8

H_SOT_IT = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Start Of Taper Position Iteration Plots', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.170898 0.0963542 0.65625 0.824219], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
  'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.173363 0.872038 0.659226 0.101106], ...
    'String','Plot Selection For Start Of Taper Position Iteration', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
  'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.21875 0.707741 0.568452 0.0647709], ...
    'String','Check The Boxes Below For Desired Plots', ...
    'Style','text', ...
    'Tag','StaticText2');
H_SOT_IT_P1 = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
'Position',[0.150298 0.603476 0.705357 0.0458136], ...
    'String','Total Power Required vs Start Of Taper Position',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_SOT_IT_P2 = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.545901 0.702381 0.0473934], ...
  'String','Rotor Drag vs Start Of Taper Position',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_SOT_IT_P3 = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.489907 0.705357 0.0458136], ...
  'String','Required Collective Pitch vs Start Of Taper Position',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_SOT_IT_P4 = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.432333 0.702381 0.0473934], ...
  'String','1st Lateral Cyclic Term vs Start Of Taper Position',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_SOT_IT_P5 = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.376338 0.705357 0.0458136], ...
  'String','1st Longitudinal Cyclic Term vs Start Of Taper Position',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_SOT_IT_P6 = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.318764 0.702381 0.0473934], ...
  'String','Coefficient of Thrust vs Start Of Taper Position',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_SOT_IT_P7 = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.26277 0.705357 0.0458136], ...
  'String','Coefficient of Power vs Start Of Taper Position',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_SOT_IT_P8 = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.205196 0.702381 0.0473934], ...
  'String','Figure of Merit vs Start Of Taper Position',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
```

```
b = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
  'Callback','create_plots_fcn plots', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.589286 0.01 0.235119 0.0677165], ...
    'String','Create Plots', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',H_SOT_IT, ...
    'Units','normalized', ...
    'Callback','out_count=1;create_plots_fcn back', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.178571 0.01 0.235119 0.0677165], ...
    'String','<< Back', ...
    'Tag','Pushbutton1');
```

APPENDIX BE. WINGSPANAREA_ITERATION_PLOTS.M

This script M-file creates a screen listing available plots for the wing span area iteration method.

```
function wingspanarea_iteration_plots()

%  Plot Routine For Wing Span Area Iteration.
%  JANRAD 98 VERSION 5.0

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.


load wingspanarea_iteration_plots

global H_WSA_IT H_WSA_IT_P1 H_WSA_IT_P2 H_WSA_IT_P3 H_WSA_IT_P4 H_WSA_IT_P5...
    H_WSA_IT_P6 H_WSA_IT_P7 H_WSA_IT_P8 H_WSA_IT_P9 H_WSA_IT_P10

H_WSA_IT = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'Name','Wing Span Area Iteration Plots', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.170898 0.0963542 0.65625 0.824219], ...
    'Tag','Fig1');
b = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
  'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.173363 0.872038 0.659226 0.101106], ...
    'String','Plot Selection For Wing Span Area Iteration', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
  'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'Position',[0.21875 0.707741 0.568452 0.0647709], ...
    'String','Check The Boxes Below For Desired Plots', ...
    'Style','text', ...
    'Tag','StaticText2');
H_WSA_IT_P1 = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
```

```
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.603476 0.705357 0.0458136], ...
    'String','Total Power Required vs Wing Span Area',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_WSA_IT_P2 = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.545901 0.702381 0.0473934], ...
  'String','Aux Thrust and Drag vs Wing Span Area',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_WSA_IT_P3 = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.489907 0.705357 0.0458136], ...
  'String','Required Collective Pitch vs Wing Span Area',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_WSA_IT_P4 = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.432333 0.702381 0.0473934], ...
  'String','Wing Lift vs Wing Span Area',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_WSA_IT_P5 = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.376338 0.705357 0.0458136], ...
  'String','Tail Rotor Power Required vs Wing Span Area',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_WSA_IT_P6 = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.318764 0.702381 0.0473934], ...
  'String','Coefficient of Thrust vs Wing Span Area',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_WSA_IT_P7 = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.150298 0.26277 0.705357 0.0458136], ...
  'String','Coefficient of Power vs Wing Span Area',...
  'Style','checkbox', ...
    'Tag','Checkbox1');
H_WSA_IT_P8 = uicontrol('Parent',H_WSA_IT, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
  'Position',[0.151786 0.205196 0.702381 0.0473934], ...
  'String','Figure of Merit vs Wing Span Area',...
  'Style','checkbox', ...
```

```
        'Tag','Checkbox1');
H_WSA_IT_P9 = uicontrol('Parent',H_WSA_IT, ...
        'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.150298 0.14376 0.702381 0.0473934], ...
        'String','Disk Loading vs Wing Span Area', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
H_WSA_IT_P10 = uicontrol('Parent',H_WSA_IT, ...
        'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.150298 0.0853081 0.702381 0.0473934], ...
        'String','Percent of Total Lift on Wing vs Wing Span Area', ...
        'Style','checkbox', ...
        'Tag','Checkbox1');
b = uicontrol('Parent',H_WSA_IT, ...
        'Units','normalized', ...
    'Callback','create_plots_fcn plots', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.589286 0.01 0.235119 0.0677165], ...
        'String','Create Plots', ...
        'Tag','Pushbutton1');
b = uicontrol('Parent',H_WSA_IT, ...
        'Units','normalized', ...
        'Callback','out_count=1;create_plots_fcn back', ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.178571 0.01 0.235119 0.0677165], ...
        'String','<< Back', ...
        'Tag','Pushbutton1');
```

APPENDIX BF. QUIT_GUI.M

This file creates GUI to verify the users intention to quit JANRAD 98.

```
function quit_gui()

% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

% JANRAD 98 VERSION 5.0

load quit_gui

a = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'MenuBar','none', ...
    'Name','Quit JANRAD 98?', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.235938 0.433333 0.389063 0.266667], ...
    'Tag','Fig1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','close (gcf)', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.188755 0.273438 0.240964 0.15625], ...
    'String','NO', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','close all,clear,clear global', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.566265 0.273438 0.240964 0.15625], ...
    'String','YES', ...
    'Tag','Pushbutton2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.192771 0.59375 0.618474 0.289062], ...
```

```
     'String','Do You Really Want to Quit JANRAD 98?', ...
     'Style','text', ...
     'Tag','StaticText1');
b = uicontrol('Parent',a, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.0401606 0.0625 0.907631 0.898438], ...
     'Style','frame', ...
     'Tag','Frame1');
```

APPENDIX BG. STABILITY_CONTROL_INPUT1.M

This M-file creates the first of two stability and control module parameter input screens

```
function stability_control_input_1()
% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load stability_control_input_1

a = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'CreateFcn','global MESH_VAL, MESH_VAL=0;;', ...
    'Name','Stability and Control Parameters', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.005 0.04 0.9975 0.89], ...
    'Tag','Fig2');
b = uimenu('Parent',a, ...
    'Label','JANRAD Options', ...
    'Tag','uimenu1');
c = uimenu('Parent',b, ...
    'Callback','performance_input_fcn quit', ...
    'Label','Quit JANRAD', ...
    'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
    'Callback','performance_input_fcn return', ...
    'Label','Return to Begining', ...
    'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
    'Callback','performance_input_fcn delta_input', ...
    'Enable','off', ...
    'Label','Change Input Parameters', ...
    'Tag','Subuimenu1');
c = uimenu('Parent',b, ...
    'Callback','performance_input_fcn about', ...
    'Label','About Janrad 98 ...', ...
    'Separator','on', ...
    'Tag','Subuimenu1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0197109 0.75 0.17477 0.0538462], ...
```

```
        'String','Flapping Moment of Inertia (slug-ft^2)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','PA=get(gcbo,"String");S_USER_INPUT.PA=str2num(PA);', ...
        'Position',[0.215506 0.751923 0.0985545 0.0480769], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0197109 0.694231 0.17477 0.0538462], ...
        'String','Hub Height Above Waterline (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','temp=get(gcbo,"String");S_USER_INPUT.temp=str2num(temp);', ...
        'Position',[0.215506 0.694231 0.0985545 0.0480769], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.021025 0.640385 0.17477 0.05], ...
        'String','Hub Fuselege Station (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','Vinf=get(gcbo,"String");S_USER_INPUT.Vinf=str2num(Vinf);', ...
        'Position',[0.215506 0.640385 0.0985545 0.05], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0197109 0.582692 0.17477 0.05], ...
        'String','Hub Position Right of Buttline (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','GW=get(gcbo,"String");S_USER_INPUT.GW=str2num(GW);', ...
        'Position',[0.21682 0.586538 0.0972405 0.0480769], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
```

```
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0197109 0.521154 0.17477 0.0538462], ...
        'String','Mast Incidence (negative fwd-degrees)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','omega=get(gcbo,"String");S_USER_INPUT.omega=str2num(omega);', ...
        'Position',[0.215506 0.528846 0.0985545 0.0480769], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0315375 0.353846 0.173456 0.0480769], ...
        'String','Height Above waterline (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','naz=get(gcbo,"String");S_USER_INPUT.naz=str2num(naz);', ...
        'Position',[0.215506 0.351923 0.0985545 0.0480769], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0341656 0.294231 0.17477 0.05], ...
        'String','Fuselage Station (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','thetao=get(gcbo,"String");S_USER_INPUT.thetao=str2num(thetao);', ...
        'Position',[0.215506 0.294231 0.0985545 0.05], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0341656 0.238462 0.173456 0.0480769], ...
        'String','Position Right of Buttline (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','Swing=get(gcbo,"String");S_USER_INPUT.Swing=str2num(Swing);', ...
        'Position',[0.215506 0.236538 0.0985545 0.0480769], ...
```

```
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0341656 0.182692 0.173456 0.0480769], ...
        'String','Alpha Zero Lift (degrees)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','bwing=get(gcbo,"String");S_USER_INPUT.bwing=str2num(bwing);', ...
        'Position',[0.215506 0.180769 0.0985545 0.0480769], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0341656 0.126923 0.173456 0.0480769], ...
        'String','CL Max', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','CLwing=get(gcbo,"String");S_USER_INPUT.CLwing=str2num(CLwing);', ...
        'Position',[0.215506 0.125 0.0985545 0.0480769], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0354796 0.0692308 0.173456 0.0557692], ...
        'String','Dynamic Pressure Ratio (page 489-Prouty)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','CDowing=get(gcbo,"String");S_USER_INPUT.CDowing=str2num(CDowing);', ...
        'Position',[0.214192 0.0711538 0.0998686 0.0480769], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.0341656 0.0269231 0.173456 0.0346154], ...
        'String','Lift Curve Slope', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
```

```
    'BackgroundColor',[1 1 1], ...
    'Callback','twist=get(gcbo,"String");S_USER_INPUT.twist=str2num(twist);', ...
    'Position',[0.21682 0.0173077 0.0985545 0.0480769], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.688073 0.729207 0.173001 0.0464217], ...
    'String','Height Above Waterline (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','a=get(gcbo,"String");S_USER_INPUT.a=str2num(a);', ...
    'Position',[0.880734 0.729207 0.0982962 0.0483559], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.688073 0.659574 0.174312 0.0483559], ...
    'String','Hub Fuselage Station (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','Taux=get(gcbo,"String");S_USER_INPUT.Taux=str2num(Taux);', ...
    'Position',[0.882045 0.659574 0.0982962 0.0483559], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',6, ...
    'Position',[0.688073 0.591876 0.174312 0.0483559], ...
    'String','Position Right of Buttline (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','Afh=get(gcbo,"String");S_USER_INPUT.Afh=str2num(Afh);', ...
    'Position',[0.882045 0.59381 0.0982962 0.0483559], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.688073 0.528046 0.174312 0.0483559], ...
    'String','Number of Blades', ...
```

```
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','Afv=get(gcbo,"String");S_USER_INPUT.Afv=str2num(Afv);', ...
        'Position',[0.882045 0.529981 0.0982962 0.0483559], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.688073 0.464217 0.174312 0.0483559], ...
        'String','Blade Chord (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','Svert=get(gcbo,"String");S_USER_INPUT.Svert=str2num(Svert);', ...
        'Position',[0.882045 0.466151 0.0982962 0.0483559], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.688073 0.398453 0.174312 0.0483559], ...
        'String','Blade Radius (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','bvert=get(gcbo,"String");S_USER_INPUT.bvert=str2num(bvert);', ...
        'Position',[0.882045 0.400387 0.0982962 0.0483559], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.688073 0.334623 0.174312 0.0483559], ...
        'String','Lift Curve Slope', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','CLvert=get(gcbo,"String");S_USER_INPUT.CLvert=str2num(CLvert);', ...
        'Position',[0.882045 0.336557 0.0982962 0.0483559], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
```

```
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.687254 0.261538 0.17477 0.0538462], ...
    'String','Rotational Velocity (rad/sec)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','CDovert=get(gcbo,"String");S_USER_INPUT.CDovert=str2num(CDovert);', ...
    'Position',[0.882045 0.272727 0.0982962 0.0483559], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.687254 0.192308 0.17477 0.0596154], ...
    'String','Flap Moment of Inertia (slug-ft^2)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','Shoriz=get(gcbo,"String");S_USER_INPUT.Shoriz=str2num(Shoriz);', ...
    'Position',[0.882045 0.206963 0.0982962 0.0483559], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.688073 0.141199 0.174312 0.0483559], ...
    'String','Delta-3 Angle (degrees)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','bhoriz=get(gcbo,"String");S_USER_INPUT.bhoriz=str2num(bhoriz);', ...
    'Position',[0.882045 0.145068 0.0982962 0.0464217], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.688073 0.0773694 0.174312 0.0483559], ...
    'String','Blade Twist (degrees)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','CLhoriz=get(gcbo,"String");S_USER_INPUT.CLhoriz=str2num(CLhoriz);', ...
    'Position',[0.882045 0.0793037 0.0982962 0.0483559], ...
    'Style','edit', ...
```

```
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','performance_input_fcn back', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.339028 0.0115385 0.164258 0.0807692], ...
    'String','<< Back', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','performance_input_fcn print', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.509855 0.00961538 0.164258 0.0807692], ...
    'String','Print Screen', ...
    'Tag','Pushbutton2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','performance_input_fcn cnx', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.339028 0.1 0.164258 0.0807692], ...
    'String','Cancel', ...
    'Tag','Pushbutton3');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback',mat2, ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.51117 0.1 0.164258 0.0807692], ...
    'String','Continue >>', ...
    'Tag','Pushbutton4');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.0175439 0.805243 0.294486 0.0898876], ...
    'String','MAIN ROTOR PARAMETERS', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.022339 0.403846 0.296978 0.0903846], ...
    'String','VERTICAL FIN PARAMETERS', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
```

```
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.755357 1.09524 0.296199 0.0831721], ...
    'String','MAIN ROTOR PARAMETERS', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.686763 0.798839 0.288336 0.0889749], ...
    'String','TAIL ROTOR PARAMETERS', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.122807 0.917603 0.763158 0.0692884], ...
    'String','STABILITY AND CONTROL PARAMETERS (PAGE 1 OF 2)', ...
    'Style','text', ...
    'Tag','StaticText3');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'FontSize',14, ...
    'FontWeight','bold', ...
    'Position',[0.360419 0.796905 0.288336 0.0889749], ...
    'String','HORIZONTAL TAIL PARAMETERS', ...
    'Style','text', ...
    'Tag','StaticText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','Shoriz=get(gcbo,"String");S_USER_INPUT.Shoriz=str2num(Shoriz);', ...
    'Position',[0.554391 0.206963 0.0982962 0.0483559], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.360053 0.196154 0.173456 0.0557692], ...
    'String','Fuselage Downwash Ratio (page 489 Prouty)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','CDovert=get(gcbo,"String");S_USER_INPUT.CDovert=str2num(CDovert);', ...
    'Position',[0.554391 0.272727 0.0982962 0.0483559], ...
```

```
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.358739 0.261538 0.17477 0.0538462], ...
    'String','Rotor Downwash Ratio (page 489 Prouty)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','CLvert=get(gcbo,"String");S_USER_INPUT.CLvert=str2num(CLvert);', ...
    'Position',[0.554391 0.336557 0.0982962 0.0483559], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.360053 0.328846 0.173456 0.0538462], ...
    'String','Dynamic Pressure Ratio (page 489 Prouty)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','bvert=get(gcbo,"String");S_USER_INPUT.bvert=str2num(bvert);', ...
    'Position',[0.554391 0.400387 0.0982962 0.0483559], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.360419 0.398453 0.174312 0.0483559], ...
    'String','Lift Curve Slope', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','Svert=get(gcbo,"String");S_USER_INPUT.Svert=str2num(Svert);', ...
    'Position',[0.554391 0.466151 0.0982962 0.0483559], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.360419 0.464217 0.174312 0.0483559], ...
    'String','Angle of Incidence (degrees)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
```

```
        'BackgroundColor',[1 1 1], ...
        'Callback','Afv=get(gcbo,"String");S_USER_INPUT.Afv=str2num(Afv);', ...
        'Position',[0.554391 0.529981 0.0982962 0.0483559], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.360419 0.528046 0.174312 0.0483559], ...
        'String','Alpha Zero Lift (degrees)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','Afh=get(gcbo,"String");S_USER_INPUT.Afh=str2num(Afh);', ...
        'Position',[0.554391 0.59381 0.0982962 0.0483559], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',6, ...
        'Position',[0.360053 0.590385 0.173456 0.0480769], ...
        'String','Position Right of Buttline (ft))', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','Taux=get(gcbo,"String");S_USER_INPUT.Taux=str2num(Taux);', ...
        'Position',[0.554391 0.659574 0.0982962 0.0483559], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.360419 0.659574 0.174312 0.0483559], ...
        'String','Fuselage Station (ft)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','a=get(gcbo,"String");S_USER_INPUT.a=str2num(a);', ...
        'Position',[0.55308 0.729207 0.0982962 0.0483559], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.359109 0.727799 0.173001 0.046332], ...
        'String','Height Above Waterline (ft)', ...
```

```
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.00626566 0.513109 0.317043 0.38764], ...
    'Style','frame', ...
    'Tag','Frame1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0075188 0.011236 0.317043 0.490637], ...
    'Style','frame', ...
    'Tag','Frame2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.338346 0.192884 0.324561 0.713483], ...
    'Style','frame', ...
    'Tag','Frame3');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.679198 0.071161 0.309524 0.835206], ...
    'Style','frame', ...
    'Tag','Frame4');
```

APPENDIX BH. STABILITY_CONTROL_INPUT2.M

This M-file creates the second of two stability and control module parameter input screens

```
function stability_control_input_2()
% This is the machine-generated representation of a Handle Graphics object
% and its children. Note that handle values may change when these objects
% are re-created. This may cause problems with any callbacks written to
% depend on the value of the handle at the time the object was saved.
%
% To reopen this object, just type the name of the M-file at the MATLAB
% prompt. The M-file and its associated MAT-file must be on your path.

load stability_control_input_2

a = figure('Units','normalized', ...
    'Color',[0.8 0.8 0.8], ...
    'Colormap',mat0, ...
    'CreateFcn','global MESH_VAL, MESH_VAL=0;;', ...
    'Name','Stability and Control Parameters page 2', ...
    'NumberTitle','off', ...
    'PointerShapeCData',mat1, ...
    'Position',[0.0025 0.0483333 0.9975 0.89], ...
    'Tag','Fig2');
b = uimenu('Parent',a, ...
    'Label','JANRAD Options', ...
    'Tag','uimenu1');
c = uimenu('Parent',b, ...
    'Callback','performance_input_fcn quit', ...
    'Label','Quit JANRAD', ...
    'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
    'Callback','performance_input_fcn return', ...
    'Label','Return to Begining', ...
    'Tag','JANRAD OptionsSubuimenu1');
c = uimenu('Parent',b, ...
    'Callback','performance_input_fcn delta_input', ...
    'Enable','off', ...
    'Label','Change Input Parameters', ...
    'Tag','Subuimenu1');
c = uimenu('Parent',b, ...
    'Callback','performance_input_fcn about', ...
    'Label','About Janrad 98 ...', ...
    'Separator','on', ...
    'Tag','Subuimenu1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
    'Position',[0.0160214 0.763359 0.174667 0.0534351], ...
    'String','Long Cyclic Pitch per inch deflection (degrees/in)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','PA=get(gcbo,"String");S_USER_INPUT.PA=str2num(PA);', ...
    'Position',[0.217867 0.76673 0.0985545 0.0478011], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0160214 0.708015 0.1749 0.0534351], ...
    'String','Lateral Cyclic Pitch per inch deflection (deg/in)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','temp=get(gcbo,"String");S_USER_INPUT.temp=str2num(temp);', ...
    'Position',[0.217867 0.709369 0.0985545 0.0478011], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0160214 0.650763 0.173565 0.0515267], ...
    'String','Collective pitch per inch deflection (deg/in)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','Vinf=get(gcbo,"String");S_USER_INPUT.Vinf=str2num(Vinf);', ...
    'Position',[0.217867 0.652008 0.0985545 0.0516252], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0160214 0.530189 0.1749 0.0528302], ...
    'String','NOTAR slv twst/defl  (deg. or in. travel) 1000 for TR', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','omega=get(gcbo,"String");S_USER_INPUT.omega=str2num(omega);', ...
    'Position',[0.218045 0.535581 0.0977444 0.0468165], ...
    'Style','edit', ...
    'Tag','EditText1');
```

```
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0291139 0.357414 0.173418 0.0361217], ...
    'String','Height Above waterline (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','naz=get(gcbo,"String");S_USER_INPUT.naz=str2num(naz);', ...
    'Position',[0.21682 0.351923 0.0985545 0.0480769], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0293725 0.290566 0.1749 0.0509434], ...
    'String','Boom Fuselage Station (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','thetao=get(gcbo,"String");S_USER_INPUT.thetao=str2num(thetao);', ...
    'Position',[0.21682 0.294231 0.0985545 0.05], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0293725 0.233962 0.173565 0.0490566], ...
    'String','Boom Position Right of Buttline  (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','Swing=get(gcbo,"String");S_USER_INPUT.Swing=str2num(Swing);', ...
    'Position',[0.21682 0.236538 0.0985545 0.0480769], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0293725 0.19434 0.173565 0.0358491], ...
    'String','NOTAR diameter (ft))', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','bwing=get(gcbo,"String");S_USER_INPUT.bwing=str2num(bwing);', ...
```

```
    'Position',[0.21682 0.180769 0.0985545 0.0480769], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0293725 0.120755 0.173565 0.0584906], ...
    'String','Swirl Angle at Boom (degrees)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','CLwing=get(gcbo,"String");S_USER_INPUT.CLwing=str2num(CLwing);', ...
    'Position',[0.21682 0.125 0.0985545 0.0480769], ...
    'String','', ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0293725 0.0792453 0.173565 0.0339623], ...
    'String','NOTAR Max Force (lbs)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','CDowing=get(gcbo,"String");S_USER_INPUT.CDowing=str2num(CDowing);', ...
    'Position',[0.215506 0.0711538 0.0998686 0.0480769], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0293725 0.0113208 0.173565 0.0528302], ...
    'String','Thruster Fuselage Station (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','twist=get(gcbo,"String");S_USER_INPUT.twist=str2num(twist);', ...
    'Position',[0.21682 0.0173077 0.0985545 0.0480769], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.68594 0.745698 0.173456 0.0458891], ...
    'String','Height Above Waterline (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
```

```
b = uicontrol('Parent',a, ...
	'Units','normalized', ...
	'BackgroundColor',[1 1 1], ...
	'Callback','a=get(gcbo,"String");S_USER_INPUT.a=str2num(a);', ...
	'Position',[0.88042 0.74761 0.0985545 0.0478011], ...
	'Style','edit', ...
	'Tag','EditText1');
b = uicontrol('Parent',a, ...
	'Units','normalized', ...
	'BackgroundColor',[0.752941 0.752941 0.752941], ...
	'Position',[0.68594 0.674952 0.17477 0.0497132], ...
	'String','Fuselage Station (ft)', ...
	'Style','text', ...
	'Tag','StaticText2');
b = uicontrol('Parent',a, ...
	'Units','normalized', ...
	'BackgroundColor',[1 1 1], ...
	'Callback','Taux=get(gcbo,"String");S_USER_INPUT.Taux=str2num(Taux);', ...
	'Position',[0.881735 0.676864 0.0985545 0.0497132], ...
	'Style','edit', ...
	'Tag','EditText1');
b = uicontrol('Parent',a, ...
	'Units','normalized', ...
	'BackgroundColor',[0.752941 0.752941 0.752941], ...
	'FontSize',6, ...
	'Position',[0.68594 0.609943 0.173456 0.0478011], ...
	'String','Position Right of Buttline (ft)', ...
	'Style','text', ...
	'Tag','StaticText2');
b = uicontrol('Parent',a, ...
	'Units','normalized', ...
	'BackgroundColor',[1 1 1], ...
	'Callback','Afh=get(gcbo,"String");S_USER_INPUT.Afh=str2num(Afh);', ...
	'Position',[0.881735 0.611855 0.0985545 0.0478011], ...
	'Style','edit', ...
	'Tag','EditText1');
b = uicontrol('Parent',a, ...
	'Units','normalized', ...
	'BackgroundColor',[0.752941 0.752941 0.752941], ...
	'Position',[0.68594 0.544933 0.17477 0.0478011], ...
	'String','Alpha Zero Lift (degrees)', ...
	'Style','text', ...
	'Tag','StaticText2');
b = uicontrol('Parent',a, ...
	'Units','normalized', ...
	'BackgroundColor',[1 1 1], ...
	'Callback','Afv=get(gcbo,"String");S_USER_INPUT.Afv=str2num(Afv);', ...
	'Position',[0.881735 0.548757 0.0985545 0.0478011], ...
	'Style','edit', ...
	'Tag','EditText1');
b = uicontrol('Parent',a, ...
	'Units','normalized', ...
	'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
    'Position',[0.68594 0.481836 0.173456 0.0497132], ...
    'String','Angle of Incidence (degrees)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','Svert=get(gcbo,"String");S_USER_INPUT.Svert=str2num(Svert);', ...
    'Position',[0.881735 0.483748 0.0985545 0.0497132], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.68594 0.355641 0.17477 0.0478011], ...
    'String','Tip Chord (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','bvert=get(gcbo,"String");S_USER_INPUT.bvert=str2num(bvert);', ...
    'Position',[0.881735 0.418738 0.0985545 0.0478011], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.68594 0.416826 0.17477 0.0478011], ...
    'String','Lift Curve Slope', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','CLvert=get(gcbo,"String");S_USER_INPUT.CLvert=str2num(CLvert);', ...
    'Position',[0.881735 0.355641 0.0985545 0.0478011], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.68594 0.286807 0.17477 0.0535373], ...
    'String','Root Chord (ft)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','CDovert=get(gcbo,"String");S_USER_INPUT.CDovert=str2num(CDovert);', ...
    'Position',[0.881735 0.290631 0.0985545 0.0478011], ...
    'Style','edit', ...
    'Tag','EditText1');
```

```
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.68594 0.217973 0.17477 0.0592734], ...
    'String','Rotor Downwash Ratio (page 489-Prouty)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','Shoriz=get(gcbo,"String");S_USER_INPUT.Shoriz=str2num(Shoriz);', ...
    'Position',[0.881735 0.225621 0.0985545 0.0478011], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.68594 0.1587 0.173456 0.0497132], ...
    'String','Fuselage Downwash Ratio (page 489-Prouty)', ...
    'Style','text', ...
    'Tag','StaticText2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[1 1 1], ...
    'Callback','bhoriz=get(gcbo,"String");S_USER_INPUT.bhoriz=str2num(bhoriz);', ...
    'Position',[0.881735 0.162524 0.0985545 0.0478011], ...
    'Style','edit', ...
    'Tag','EditText1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','performance_input_fcn back', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.339028 0.0115385 0.164258 0.0807692], ...
    'String','<< Back', ...
    'Tag','Pushbutton1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','performance_input_fcn print', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.510013 0.0114504 0.164219 0.0801527], ...
    'String','Print Screen', ...
    'Tag','Pushbutton2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'Callback','performance_input_fcn cnx', ...
    'FontSize',12, ...
    'FontWeight','bold', ...
    'Position',[0.339119 0.101145 0.164219 0.0801527], ...
    'String','Cancel', ...
    'Tag','Pushbutton3');
b = uicontrol('Parent',a, ...
```

```
        'Units','normalized', ...
        'Callback',mat2, ...
        'FontSize',12, ...
        'FontWeight','bold', ...
        'Position',[0.51117 0.1 0.164258 0.0807692], ...
        'String','Continue >>', ...
        'Tag','Pushbutton4');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',14, ...
        'FontWeight','bold', ...
        'Position',[0.0225564 0.816479 0.290727 0.0898876], ...
        'String','RIGGING PARAMETERS', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',14, ...
        'FontWeight','bold', ...
        'Position',[0.0200501 0.400749 0.298246 0.0505618], ...
        'String','NOTAR PARAMETERS', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',14, ...
        'FontWeight','bold', ...
        'Position',[0.755357 1.09524 0.296199 0.0831721], ...
        'String','MAIN ROTOR PARAMETERS', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',14, ...
        'FontWeight','bold', ...
        'Position',[0.68797 0.797753 0.289474 0.0898876], ...
        'String','WING PARAMETERS', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',14, ...
        'FontWeight','bold', ...
        'Position',[0.106516 0.917603 0.763158 0.0674157], ...
        'String','STABILITY AND CONTROL PARAMETERS (PAGE 2 OF 2)', ...
        'Style','text', ...
        'Tag','StaticText3');
b = uicontrol('Parent',a, ...
```

```
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',14, ...
        'FontWeight','bold', ...
        'Position',[0.358396 0.754682 0.286967 0.151685], ...
        'String','CG LOCATION & INERTIAS/FUSELAGE PARAMETERS', ...
        'Style','text', ...
        'Tag','StaticText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','CDovert=get(gcbo,"String");S_USER_INPUT.CDovert=str2num(CDovert);', ...
        'Position',[0.551905 0.248566 0.0985545 0.0478011], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.356475 0.237094 0.17477 0.0535373], ...
        'String','Fuselage Downwash Ratio (page 513 Prouty)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','CLvert=get(gcbo,"String");S_USER_INPUT.CLvert=str2num(CLvert);', ...
        'Position',[0.551905 0.313576 0.0985545 0.0478011], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.356475 0.304015 0.173456 0.0554493], ...
        'String','Ixz (slug ft^2)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','bvert=get(gcbo,"String");S_USER_INPUT.bvert=str2num(bvert);', ...
        'Position',[0.551905 0.376673 0.0985545 0.0478011], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.356475 0.374761 0.173456 0.0478011], ...
        'String','Izz (slug ft^2)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
```

```
        'Callback','Svert=get(gcbo,"String");S_USER_INPUT.Svert=str2num(Svert);', ...
        'Position',[0.551905 0.441683 0.0985545 0.0497132], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.356475 0.438931 0.173565 0.0496183], ...
        'String','Iyy (slug ft^2)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','Afv=get(gcbo,"String");S_USER_INPUT.Afv=str2num(Afv);', ...
        'Position',[0.551905 0.506692 0.0985545 0.0478011], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.356475 0.50478 0.173456 0.0478011], ...
        'String','Ixx (slug ft^2)', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','Afh=get(gcbo,"String");S_USER_INPUT.Afh=str2num(Afh);', ...
        'Position',[0.551905 0.56979 0.0985545 0.0478011], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'FontSize',6, ...
        'Position',[0.356475 0.564885 0.172596 0.0477099], ...
        'String','CG Position Right of Buttline (ft))', ...
        'Style','text', ...
        'Tag','StaticText2');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[1 1 1], ...
        'Callback','Taux=get(gcbo,"String");S_USER_INPUT.Taux=str2num(Taux);', ...
        'Position',[0.551905 0.634799 0.0985545 0.0497132], ...
        'Style','edit', ...
        'Tag','EditText1');
b = uicontrol('Parent',a, ...
        'Units','normalized', ...
        'BackgroundColor',[0.752941 0.752941 0.752941], ...
        'Position',[0.356475 0.633588 0.172596 0.0496183], ...
        'String','CG Fuselage Station (ft)', ...
        'Style','text', ...
```

```
     'Tag','StaticText2');
b = uicontrol('Parent',a, ...
     'Units','normalized', ...
     'BackgroundColor',[1 1 1], ...
     'Callback','a=get(gcbo,"String");S_USER_INPUT.a=str2num(a);', ...
     'Position',[0.550591 0.705545 0.0985545 0.0478011], ...
     'Style','edit', ...
     'Tag','EditText1');
b = uicontrol('Parent',a, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.356475 0.704198 0.171278 0.0458015], ...
     'String','CG Height Above Waterline  (ft)', ...
     'Style','text', ...
     'Tag','StaticText2');
b = uicontrol('Parent',a, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.0160214 0.590566 0.1749 0.0528302], ...
     'String','theta0t/pedal deflection (deg/in or deg/deg)', ...
     'Style','text', ...
     'Tag','StaticText2');
b = uicontrol('Parent',a, ...
     'Units','normalized', ...
     'BackgroundColor',[1 1 1], ...
     'Callback','Vinf=get(gcbo,"String");S_USER_INPUT.Vinf=str2num(Vinf);', ...
     'Position',[0.217867 0.594646 0.0985545 0.0516252], ...
     'Style','edit', ...
     'Tag','EditText1');
b = uicontrol('Parent',a, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.0160214 0.466038 0.1749 0.0509434], ...
     'String','Max Rudder Deflection (deg or in. travel)', ...
     'Style','text', ...
     'Tag','StaticText2');
b = uicontrol('Parent',a, ...
     'Units','normalized', ...
     'BackgroundColor',[1 1 1], ...
     'Callback','omega=get(gcbo,"String");S_USER_INPUT.omega=str2num(omega);', ...
     'Position',[0.217623 0.479245 0.0987984 0.0471698], ...
     'Style','edit', ...
     'Tag','EditText1');
b = uicontrol('Parent',a, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
     'Position',[0.0160214 0.760377 0.1749 0.0528302], ...
     'String','Long Cyclic Pitch per inch deflection (degrees/in)', ...
     'Style','text', ...
     'Tag','StaticText2');
b = uicontrol('Parent',a, ...
     'Units','normalized', ...
     'BackgroundColor',[0.752941 0.752941 0.752941], ...
```

```
    'Position',[0.0112782 0.464419 0.313283 0.451311], ...
    'Style','frame', ...
    'Tag','Frame1');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.0125313 0.00374532 0.313283 0.455056], ...
    'Style','frame', ...
    'Tag','Frame2');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.344612 0.224719 0.315789 0.689139], ...
    'Style','frame', ...
    'Tag','Frame3');
b = uicontrol('Parent',a, ...
    'Units','normalized', ...
    'BackgroundColor',[0.752941 0.752941 0.752941], ...
    'Position',[0.682957 0.134831 0.310777 0.779026], ...
    'Style','frame', ...
    'Tag','Frame4');
```

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